THE

ELECTRICAL REVIEW.

VOL. XLV. DECEMBER 8, 1899. No. 1,150.

CONTENTS:

	PAGE
Electrical Finance	909
The Liability of a Supply Company to meet the Demands of Consumers	910
Some Experiments on Voltaic Cells with Compound Electrodes (*illustrated*)	911
The Advantages of Long Filaments in Incandescent Lamps (*illustrated*)	912
Return Feeders for Electric Railways (*illustrated*) (*continued*)	913
Board of Trade Regulations	915
The "Latent Dangers" of Electricity	916
Accumulators and Vehicles	916
Greenock Electricity Works	917
Correspondence:—Signalling without Contact	917
Electric Cranes	918
Tested Lamps	918
Influence of Cheap Fuel on the Cost of Electrical Energy	919
An Electrical Supply Question	919
Three-Wire System of Distribution	919
Business Notices, &c.	919
The Perth (W.A.) Electricity Works (*illustrated*)	927
A Water-Power Transmission Plant (*illustrated*)	928
Large Electric Generators (*illustrated*)	930
Supply Station Accounts	936
City Notes	936
Traffic Receipts	938
Stocks and Shares	938
Share List of Electrical Companies	939
Market Quotations	940
Applications to Parliament for Electrical Powers (*continued*)	941
Tests of Rail Bonds	942
New Electrical Works at Preston	942
London County Council and Electric Lighting Loans	942
Heat Absorptive Power of Water	943
Electricity in Warships	944
Northern Society of Electrical Engineers:—Methods of Suppressing Arcs in Switches, Fuses, &c. (*illustrated*)	944
Cost of Central Station Plant (*concluded*)	946
New Patents	947
Abstracts of Published Specifications	948

THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

Edition

NOW IN PREPARATION.

E. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON. E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON.

Telegraphic Address: "ASHRAY, LONDON." Code A B C.

Telephone No. 968 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 18s. 6d. To all other countries, per Year, $1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 4s. or Free by Post (in Great Britain), 5s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU 82, Rue de la Banque. *Berlin:* ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office London, to be made payable to the H. ALABASTER, 4, Ludgate Hill, E.C.

ELECTRICAL FINANCE.

AMID the general prosperity which at present prevails in the electrical and allied industries, it would seem a gratuitous act to utter a discordant note, yet a careful survey of the whole of the conditions of electrical undertakings leads inevitably to the conclusion that there are some undesirable features connected with the financial side of the business. We do not say that the greater portion of the work being carried on is unsound, for this side of the question does not concern us so much as the fictitious value which is put upon electrical inventions and processes when they are brought before the investing public. In other words, the tendency among electrical companies is unmistakably towards over-capitalisation. This arises mainly from the overweening desires of promoters and vendors. No reasonable being grudges the due reward of inventors, but the demands of this sometimes useful class of persons are out of all proportion to those who help to bring the invention before the public. The ways of the average company promoter are as disagreeable as they are immoral. He not only seeks a high reward for himself, but he is wilfully extravagant.

In the initiation of a company, "preparing the way" seems to be an inseparable operation, and this when it takes the form of buying Press notices of a favourable character is apt to be a somewhat expensive process. We have recently had evidence that companies floated under the highest auspices are not free from this practice. While it may be said that the promotion of electrical companies has been comparatively free from many of the abuses that characterise joint stock enterprise, there has been undoubtedly a strong disposition on the part of vendors to place a high value on their services, and though large sums have been asked from the public it has frequently left inadequate working capital.

That it has been possible to successfully float some of the companies we have in mind, only shows with what extreme favour the public regard electrical affairs. Of the various branches of electrical enterprise, probably the one section that has been hitherto most free from the "promoting" element, is the supply undertakings; it is quite true that there have been in connection with it some remarkable instances of the enhanced value of founders' shares, but then these only became of value when the success of the concern was firmly established. Recently, however, there have been sundry enterprises started for the supply of electrical energy in various districts, where the demands of the vendors have been out of all proportion to the work they have conducted; the outlay of a few hundred pounds for a provisional order has been held good enough to demand 30 or 40 times that sum from the public. Probably, a well-conducted supply system might recover even from that rapacity, but when we witness the attempts made to float companies with a quarter

or half a million for the working of mere processes, one may be pardoned for making close inquiries into the whole of the circumstances. There are many valuable electro-chemical and electro-mechanical devices which are the subject of patents, but how many are there which would justify the formation of a company with a quarter of a million capital. One of the most striking and remarkable features about present-day company flotation is, that large sums are asked for processes which have not been developed on a commercial scale. It is all very well to erect an experimental plant to prove the possibility of manufacturing certain materials, but even if the most conspicuous success is obtained under experimental conditions, there is absolutely no justification for asking the public to subscribe an enormous capital. In the commencement of new operations we believe in moderation, but, obviously, this is opposed to all the canons of the company promoter, and hence we see concerns brought out with share capital which would be farcical if it did not menace very seriously the future of the electrical industry. It is almost useless to recall the financial disasters of 1882, because they probably would not have much application to-day. Electrical apparatus and processes are in quite a different position; at the same time, the financial recklessness which characterises many latter-day promoters has much in common with the tactics of the period to which we have alluded. There is a rather remarkable feature in connection with the bringing out of electrical companies, that is, the most successful from a flotation point of view, are those which are looked upon by electrical men with suspicion; and, on the other hand, many sound concerns with moderate demands have met with little support from the investing public. Intrinsic worth, unfortunately, is not appreciated in the market, specious promises and exaggerated statements often receiving greater support. It is obvious that an era of prosperity in any industry brings in its train all sorts of impracticable, unsound, and uncommercial schemes, and we may take it for granted that the industry with which we are so intimately associated will not be wholly free from these evils. The financial press is a mighty power for good and for ill, but, with a few honourable exceptions, one cannot hope for its aid in the direction of sound finance. It is not necessary to dwell upon particular instances of over-capitalisation in electrical work; they, unfortunately, are to be found in most of the multifarious branches, though if one were to make an exception, it would be in favour of electric traction, which has probably suffered less from the promoter than the other applications of electricity. We are afraid that the watering of capital from which many organisations are suffering, is responsible for the somewhat unsound methods adopted in the making up of accounts; indeed, we may go so far as to say that there are but few industrial concerns in whose books the patents and goodwill do not figure at a highly fancy value. Moreover, one can hardly commend the manner in which depreciation is treated occasionally by electrical companies; there is too little suggestion of permanence, and though one might expect an electrical supply company, whose business is held only on a short lease, to adopt certain expediencies of book-keeping, there is no reason why a manufacturing concern should adopt methods that are foreign to a sound and growing business.

THE LIABILITY OF A SUPPLY COMPANY TO MEET THE DEMANDS OF CONSUMERS.

In our issue of last week one of our correspondents raised the question whether an electricity supply company is bound to provide current to applicants who have their own plant for lighting purposes, but who wish to have the company to fall back upon in case of a breakdown, or to take current from them when it may be convenient. In order to answer this question it is necessary to refer, in the first place, to the Electric Lighting Act of 1882. It is there provided by Section 19 that where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided by the terms of the license, order, or special Act authorising such supply, every company or person within that part of the area shall on application be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply. This section makes the supplying of electricity practically compulsory, but the provisions of the Electric Lighting (Clauses) Act of 1899, which are identical with the form of provisional order hitherto in common use, make certain regulations as to supply which ease the burden of the company.

By Clause 27 of the Schedule to the Act of 1899, which is now incorporated with every provisional order, undertakers (*e.g.*, the supply company) are bound, upon being required to do so by the owner or occupier of any premises situate within 50 yards from any distributing main of the undertakers . . . . . to furnish and lay any electric lines that may be necessary for the purpose of supplying the maximum power to which the owner or occupier is entitled. The cost of any electric line to be used for conducting the current from the mains to the consumers' premises is to be borne by the supply company, if it is only 60 feet in length. The expense of providing additional wire shall, if the undertakers so require, be defrayed by the owner or occupier. The most important provision, from the undertaker's point of view, is contained in Clause 27 (2) (*b*), which provides that every owner or occupier of premises requiring a supply of energy, if required by the undertakers, must enter into a written contract with them to continue to receive and pay for a supply of energy for a period of *at least two years* of such an amount that the payment to be made for the supply, at the rate of charge for the time being charged by the undertakers . . . . . shall not be less than 20 per cent. per annum on the outlay incurred by the undertakers in providing any electric line required under the Section. The undertakers are also empowered (by Section 3) to demand security for the payment of all moneys to become due in respect of such supply, and in default of security being given, they may discontinue the supply of electricity. By Clause 27 (5) the undertakers are relieved from the obligation to provide any supply unless they are reasonably satisfied that the electric lines, &c., on the consumers' premises are in good order and condition. By Clause 30, the undertakers are made liable to a penalty not exceeding 40s. for each day on which they make default in supplying electricity. A glance at the above enactments will show the exact position of the supply company. Nothing is said in any statute which can be taken as excusing them from supplying to consumers who have their own plant.

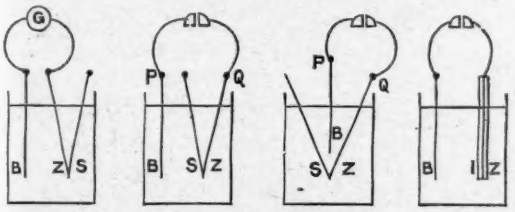
SOME EXPERIMENTS ON VOLTAIC CELLS WITH COMPOUND ELECTRODES.

By FREDERICK S. SPIERS, B.Sc.

1. The experiments about to be described here arose out of an investigation on the action of the zinc which is usually placed in boilers, and which is supposed to prevent, or at least diminish, the electrolytic corrosion of the steel plates or tubes.

2. In the course of some work on this subject, the author and Mr. M. Solomon happened to be experimenting with the voltaic combination shown in fig. 1. B was a plate of brass, Z a plate of zinc, and S one of steel; Z and S were in contact under the electrolyte, which was ordinary tap water, while B and Z were connected through a galvanometer which, when shunted, had a resistance of about 7 ohms. It was then noticed that the galvanometer deflection varied according to the positions of the zinc and steel plates relatively to the brass. When the zinc plate faced the brass, the deflection was considerably greater than when it was faced by the steel. (It should be mentioned that the internal resistance of the cell must have been very high compared with that of the outside circuit.)

This unexpected * phenomenon naturally suggested trying whether the P.D. between the terminals of the cell, as measured electrostatically, varied in the same peculiar manner with the varying positions of the plates. With the plates arranged as in fig. 2, the P.D. between the points, P and Q, as measured on a quadrant electrometer, was about 0·6 volt, which is approximately the E.M.F. of a brass-steel voltaic couple after immersion for an hour or so. When the compound electrode was reversed, so that the zinc faced



Figs. 1, 2, 3 and 4.

the brass, the P.D. between the same points was about 0·9 volt, that is, somewhat less than the E.M.F. of a brass-zinc combination. In the intermediate position (fig. 3) the P.D. was about 0·75 volt. Moving the plates closer to one another had no apparent effect. It might be useful to give a rough idea of the dimensions of the cell. The plates were about 4 inches × 1½ inches, and were half immersed; the cell was a glass beaker of about 4 inches diameter.

3. The effect was observed in a still more striking fashion by binding together discs of iron and zinc and suspending the couple in the same cell (fig. 4). Different specimens of metal were used in this case. When the iron faced the brass, the voltage was 0·36. When the zinc faced the brass, the voltage was 0·48. When the edge of the disc faced the brass, it was 0·41. The effect was the same, whether the electrometer connection was made to the iron or to the zinc.

4. As regards the explanation of these experiments, it was first thought that the effects observed were analogous to those obtained in experiments on the "volta" effect. If the contact P.D. between two plates be measured in the ordinary way, the effect depends only on the physical state of those surfaces of the plates that face one another, and not at all on the state of the back surfaces. That the same state of affairs did not exist in these experiments was shown by electroplating with copper an iron rod, and then making a voltaic couple of this rod and a sheet of copper. When the iron was completely covered with copper, there was naturally no P.D. between the rod and sheet: but no sooner was a small speck of iron made visible by filing away the copper coating, than the P.D. rose to about 0·15 volt, *even when the iron speck was not facing the copper sheet.* As more iron became visible, the P.D. between the terminals of the cell continued to rise. The actual results are best shown diagrammatically. The shaded strip in fig. 5 represents the surface of iron visible.

(*a*) P.D. = 0·15 volt for all positions of the speck.
(*b*) 1. P.D. = 0·22 volt when the iron strip faced the copper sheet.
2. P.D. = 0·18 volt when the iron strip was turned away from the copper sheet.
(*c*) 1. P.D. = 0·24 volt, iron strip facing copper.
2. P.D. = 0·20 volt, iron strip turned away from copper.
(*d*) Half copper, half iron.
1. P.D. = 0·26 volt, iron facing copper.
2. P.D. = 0·31 volt, iron turned away from copper.
(*e*) All copper removed. P.D. = 0·42 volt.

These experiments, and particularly (*a*), show that the analogy to the "volta" experiment is not complete, for there no currents at all are flowing (excepting, of course, momentary displacement currents), while here, there is a local current flowing between the two dissimilar metals in contact. And it appears that it is this local current that

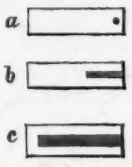


Fig. 5.

causes the curious phenomena recorded above, for what the quadrant electrometer really measures in all those cases is the E.M.F. of a voltaic couple as modified by the drop or rise of potential, as the case may be, due to the stream lines of the local current between the plates in contact.

5. Thus, consider again the simple case discussed at first (see fig. 6). The stream lines of the local current here flow from the zinc (z) through the electrolyte to the iron (I). To find the P.D. between P and Q, where, to fix our ideas, we take P and Q as points on the copper conductors attached to the electrodes, as shown, we have to take a unit of positive electricity, by *any path whatever*, from P to Q, and determine how much work has been done in the process. If the unit is taken from Q through the *iron* plate to P, the P.D. is given by the *sum* of the E.M.F. of a brass-iron voltaic couple and the rise of potential along a *small* length of a

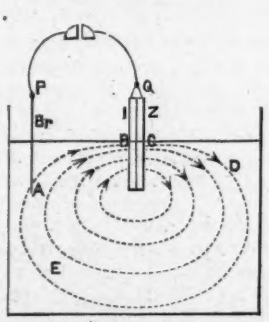


Fig. 6.

stream line, such as A B. If the unit is taken from Q through the zinc plate to the brass, the P.D. is the E.M.F. of a brass-zinc couple *lessened* by the drop of potential along a *long* length of a stream line, such as C D E. In both cases the resultant P.D. should work out the same. If, however, the iron-zinc couple is reversed, the P.D. between P and Q will be given by the *sum* of the E.M.F. of a brass iron couple and

D

* In an exceedingly interesting paper by Mr. A. P. Laurie, B.A., B.Sc., in the *Journal of the Chemical Society* for 1888, p. 104, I find the following statement:—"If, instead of a simple metal, a mixture of two metals is introduced into a voltaic cell, the E.M.F. of the cell is that of the more positive metal. . . . . Some experiments in a cuprous iodide cell, with plates of copper having pieces of zinc soldered on to them of about $\frac{1}{1000}$th of the whole area of the plate, showed this." [Op. § 5 (a)]. I confess my inability to reconcile this statement of Mr. Laurie with my own experimental results.

the rise of potential along a *long* length of stream line, such as C D E, or, what comes to the same thing, the E.M.F. of a brass-zinc couple *lessened* by the drop of potential along a *short* length of stream line, such as A B. The resultant P.D. in this case is clearly greater than in the former case. In case (*a*) of the experiment described just above (Section 4, fig. 5), there is a great crowding of steam lines round the iron speck, and all are concentrated within quite a small volume (fig. 7), hence for all positions of the speck, the P.D. between P and Q is the same. As, however, the speck becomes enlarged, the stream lines spread out to some distance, and therefore the P.D. between P and Q depends on the relative position of the plate, Q, just as it did in the original experiments quoted.

(To be continued.)

THE ADVANTAGES OF LONG FILAMENTS IN INCANDESCENT LAMPS.*

When it was recognised by Edison and his co-workers some 20 years ago that the incandescent lamp was not suited for series work, but should be run on multiple constant-potential circuits, it was at once seen that these constant-potential circuits should be of as high a voltage as lamp construction would permit in order to make possible the distribution of the current over any reasonable distance from the dynamos. After considerable experimenting it was found possible to make lamps of a resistance high enough to withstand 100 volts, and this, with a margin of a few volts for full measure, making it 110 volts, came to be the standard recognised pressure of incandescent circuits.

During the 20 years since that time the incandescent lamp has been the object of as elaborate investigation and experimentation as any other one product of the mechanical arts, an enormous amount of time, money, and labour having been spent in its development, and with no mean results; but even at the present day, although lamps can be made for 240 volts, difficulties are encountered in making as good a lamp for the original standard pressure of 110 volts as can be made for lower pressure.

One of the difficulties in the way of raising the voltage of incandescent lamps may be illustrated as follows:—Assuming that the lamp is to be of 16 C.P. and of 3·5 watts per candle, its total consumption of power will be 16 × 3·5, or 56 watts. If burned on a circuit of about 56 volts this power will require 1 ampere, and the resistance of the lamp filament will have to be about 56 ohms. If, however, it is to burn on a circuit of 112 volts the power can only be kept down to 56 watts by cutting down the current to ½ ampere and the resistance of the lamp will have to be raised to 224 ohms. Thus it will be seen that doubling the voltage increases the necessary resistance four times, which is in accordance with a general law of purely resistive apparatus that the resistance must be varied as the square of the pressure to maintain the absorbed power constant. If the lamp is designed for a 220-volt circuit the current will have to be reduced to about ¼ of an ampere and the resistance will have to be raised to the extremely high value of practically 900 ohms to give the same economy of current. As the resistance of the carbon falls with increased temperature, the resistance cold is practically twice this, or, in the last case, 1,800 ohms.

The only way to obtain the high resistances of from 200 to 300 ohms necessary for lamps of 100 to 120-volt circuits is by using either a material of high specific resistance or of great length and fine diameter. Extended experiments in the direction of finding a suitable material of high specific resistance by means of incorporating more highly resistive substances with carbon, or otherwise, have uniformly proven in vain, the only material as yet found available being carbon in two of its allotropic forms. One of these is a variety similar to very dense charcoal, and formed by the carbonisation of the original cellulose thread of which practically all filaments nowadays are made. This form is known by lamp makers as "base" carbon. The other is a form of carbon closely resembling ordinary graphite.

All lamp filaments must contain as a foundation a central core of the former, or "base" carbon, filaments constituted wholly of graphite being impossible to make, since the graphite can only be obtained in the filament form by depositing it upon a skeleton structure of "base" carbon. This deposition is done by means of what is called the "flashing" or "treating" process. The carbonised cellulose thread is raised to high incandescence by electric current in a chamber through which is passed a current of gasolene vapour. The white-hot filament decomposes the hydrocarbon vapour, depositing the carbon as graphite upon its surface.

The "base" carbon has about six times the specific resistance of the graphitic carbon, so that filaments consisting wholly or largely of the former can be made much shorter and thicker for the same resistance than those containing a greater percentage of graphite. Unfortunately, however, the "base" carbon is much poorer in the qualities of economical light emission and life. This is not due, as many suppose, to any difference between the light-giving powers of graphite and charcoal; in fact, it is generally admitted that all substances, no matter what their colour, white, gray, or black, shine with the same intensity when raised to the same temperature of incandescence. But the graphite gives to the surface of the carbon a gray, metallic, steel-like appearance which can be plainly seen in all new lamps, and this gray surface, in conformity with a general law of physics, radiates much less heat when raised to a given temperature than does a dead black or sooty surface such as that of the "base" carbon or that of an old lamp in which

Fig. 1. Fig. 2.

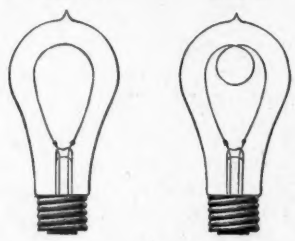
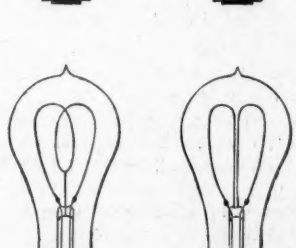


Fig. 3. Fig. 4.



the surface of the graphite may have been reduced to the charcoal form. A filament, therefore, with a metallic gray surface requires less energy to supply this heat waste and raise it to the proper temperature of incandescence, such, for example, as to radiate 1 C.P. for every 3½ watts supplied, hence the superiority of the graphite for the economical emission of light.

Another superiority of the flashed or treated filament is mechanical. The graphite tube or sleeve which surrounds the "base" carbon is more dense and stiff than its central core, and hence holds the filament more rigidly against vibrations which tend to throw it against the glass, and also prevents it from sagging when the lamp is burned in a horizontal position. The graphite tube, deposited as it is at a high temperature, is a good resistant of the disintegrating effects of heat, and maintains the filament probably after the core of "base" carbon within it is broken down, thus greatly prolonging the life.

As stated above, the graphite is a good conductor of electricity as compared with "base" carbon, and hence if

* *American Electrician.*

much of the cross section of the filament is graphite the diameter of the whole will have to be small and the length great, in order to obtain the necessary 200 or 300 ohms. The greater the amount of graphite and the less the amount of "base" carbon the better is the lamp for reasons pointed out above, and the general rule may be laid down that for a given voltage a lamp with a long filament is better than a lamp with a short filament, provided—and this is an important provision—the long filament is properly supported.

From the inception of the industry until a few years ago most incandescent lamps had filaments of the plain loop or horse-shoe type, such as is shown in fig. 1 of the accompanying cut. The filaments were thick and short, and little or no treatment was employed. As the superiority of the longer type became apparent the filament was given a loop or coil which allowed its length to be increased without enlarging the bulb, and its percentage of graphitic low resistance carbon to be increased with it, so that this filament took the familiar form shown in fig. 2. A variation upon it was the addition of more turns in the coil.

While this form is still made, it is largely giving way to another type developed by increasing the diameter of the coil and anchoring its lowermost point as illustrated in fig. 3, this being known as the oval anchored type. This allows a further increase of the length and percentage of low resistance graphite and is made in spite of several disadvantages. One of these is the impossibility of practically anchoring the filament during the process of flashing so that unsupported this process cannot be carried on at as high a heat as is desirable without badly warping the filament. The graphite deposited is more dense and stable with the higher temperatures of flashing, which cannot be obtained on the oval anchored filament. The cement used at the anchored point also causes trouble. This point being distant from the glass supporting the anchor wire and being heated in two directions and cooled in only one, rises to a high heat, throwing off gases within the bulb, which combine with the carbon on the surface of the filament to darken the latter, thereby tending to spoil the metallic gray finish which gives the lamp a high efficiency by reducing the amount of energy necessary to maintain the filament at the proper temperature, as pointed out above. In spite of these faults, however, the perfected oval anchored type is far superior to its predecessors, solely because a greater proportion of the filament's bulk is of the purer, denser form of carbon.

A further step in the support of long filaments is taken by making the filament in two pieces connected in series with each other, as shown in fig. 4, which illustrates what is commonly known as the double filament type. This double filament consists practically of two 8-C.P. 50 to 60-volt filaments connected in series with each other by means of a short piece of wire bedded in the glass and cemented at its two ends respectively to one end of each filament. In this lamp there is no oval coil to twist out of shape and short circuit on itself. The loop shape of the two filaments allows the deposit of graphitic carbon to be made at a higher temperature, making it dense and hard and durable.

For high voltage lamps, that is, those intended for 200 to 240-volt circuits, mechanical difficulties of course arise in making and supporting filaments of twice the length and half the cross section of those for 100 to 120-volt lamps. The result is that comparatively little or no "treatment" can be applied to such filaments without making their resistance too small, which accounts for their failure to equal 100 to 120-volt lamps in the qualities of efficiency and longevity. Still other expedients of support have to be used with these high voltage filaments such, for example, as anchoring two points, &c.

An idea of the proportions of graphitic to "base" carbon in modern 3·1-watt, 16-C.P., 100-volt lamps can be gained from the fact that lamps of the oval anchored type are treated down to approximately one-third of the original resistance of the base of the filament, whilst those of the double filament type are treated down to less than one-quarter of the original resistance, this reduction being accomplished by depositing a tube or sleeve of graphitic carbon with a thickness of about one-tenth of the diameter of the finished filament, thus making about one-third of its cross-section graphite, the inside four-fifths diameter, or two-thirds cross-section being "base" carbon.

RETURN FEEDERS FOR ELECTRIC RAILWAYS.

(*Continued from page* 223.)

By means of the graphic construction explained in the previous article, the sections of the cables can be readily determined for any given series of points of connection.

We shall discuss the method by the help of an example. Let the length of the line as in previous examples be 18 kilometres; the total current supplied 540 amperes, and the number of points at which the current is delivered, 18. Let the return cables be connected at 3, 9, 12, and 16 kilometres, and let there be also an end cable. The distribution of current under these circumstances is represented in fig. 4.

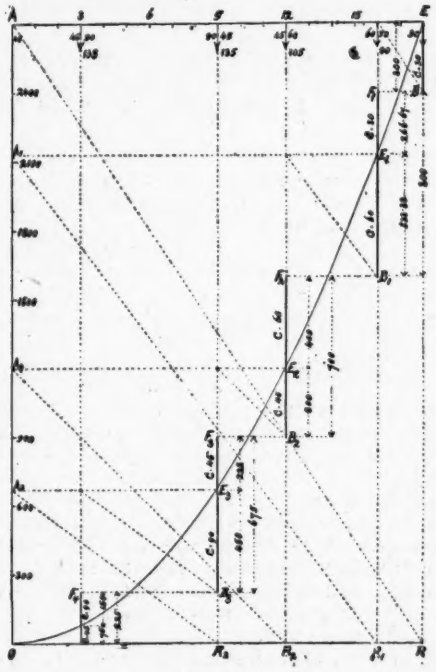


Fig. 4.

As has been already shown, the cross-section s_e of the end cable is proportional to its distance from the nearest intermediate cable, *i.e.*, $s_e : \Sigma (s) = 2 : 18$; and $s_e = 2{,}700 \times \frac{2}{18} = 300$ mm². We obtain this section by drawing from the connecting point, 16, on the diagram, a straight line parallel to the diagonal A R of the rectangle A E R O, till it cuts the side E R; the length E B cut off is the required section.

To obtain the section of the nearest intermediate cable, draw a perpendicular through the point 16 to cut the parabola in the point E_1. Assume for the moment that the line ends at 16 kilometres; then the total section required in this case is represented by the line $E_1 R_1$, and we obtain the section of the end cable by a construction similar to that given above, *i.e.*, draw from the point of intersection of the 12-kilometre line and the line $A_1 E_1$, a line parallel to the diagonal $A_1 R_1$. B_1 the point of intersection of this diagonal with the line $E_1 R_1$ gives the lower limit of the line, $F_1 B_1$ representing the section of the first intermediate cable. The lines representing the sections of the remaining cables are obtained by exactly similar constructions. The sections obtained for the end cable, and the 16, 12, 9, and 3 km. cables are 300, 800, 700, 675, and 225 mm² respectively.

It is now necessary to prove that the lengths $F_1 E_1$, $F_2 E_2$ . . . . . have the cross-sections required to draw off half the current in their respective sections of the line. Since currents which the cross-sections E B + $F_1 E_1$, $E_1 B_1$ + $F_2 E_2$ and so on, draw off are equal, the lines (E B) and (F E) must be proportional to the respective lengths of the cables. If we denote

the total length of the line by L, and the length of the cable connected to the point next to the end by l; the equation to the parabola gives $i^2 = \frac{2 L K \Delta}{C} s$; hence $s = \frac{i^2 C}{2 L K \Delta}$, and since $\Sigma(s) = \frac{C L}{2 K \Delta}$, it follows that

$$s = \frac{i^2 \Sigma(s)}{L^2}.$$

Now, from the figure

$$E B + F_1 E_1 = \Sigma(s) - s$$
$$= \Sigma(s) \left\{ 1 - \frac{i^2}{L^2} \right\}$$
$$= \Sigma(s) \frac{L^2 - i^2}{L^2}.$$

But by construction

$$E B = \Sigma(s) \frac{L - l}{L}$$

Therefore

$$F_1 E_1 = \Sigma(s) \left\{ \frac{L^2 - i^2}{L^2} - \frac{L - l}{L} \right\}$$
$$= \Sigma(s) \left\{ \frac{(L + l)(L - l)}{L^2} - \frac{L - l}{L} \right\}$$
$$= \Sigma(s) \frac{L - l}{L} \left\{ \frac{L + 1}{L} - 1 \right\}$$
$$= \Sigma(s) \frac{L - l}{L} \cdot \frac{l}{L}$$

If now we find the ratio of $F_1 E_1$ to E B, it is

$$\frac{F_1 E_1}{E B} = \frac{l}{L}.$$

That is to say, the lines $F_1 E_1$ and E B on the diagram are in the ratio of the lengths of the cables which they represent.

A similar proof can be applied to the lines $F_2 E_2$, and $E_1 B_1$, and so on.

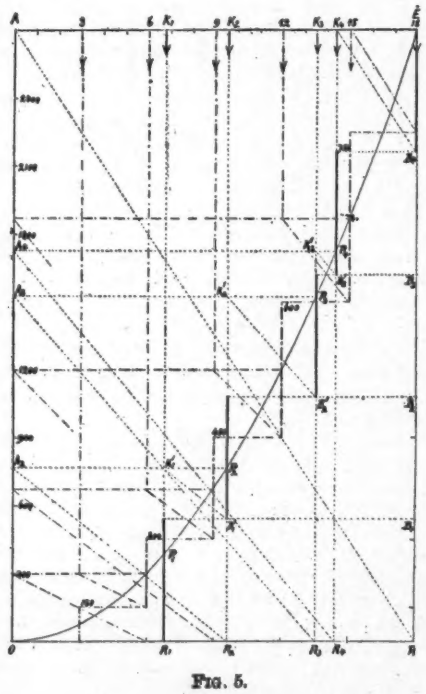


Fig. 5.

This demonstrates that the construction in fig. 4 gives the correct cross-section of each cable.

The construction just explained for finding the cross-sections of the cables when the points of connection to the line are given, may also be applied to solve the converse problem, namely, when the cross-sections of the cables are given, to find the points at which they should be connected to the line. The solution of this latter problem is of importance when commercial standard sections have to be used.

We shall show how to apply the construction to the case in which all the return cables have the same cross-section.

Let the total cross-section of the cables be, as before, 2,700 mm²; and let five return cables all of the same cross-section (540 mm²) be made use of. The line E R, fig. 5, is divided into five equal parts, at the points B_1, B_2, B_3, B_4

Through the point B_4 a line $B_4 K_4$ is drawn parallel to the diagonal A R. K_4, the point of intersection with the line A, gives the point of connection (14·25 km.) of the first intermediate cable.

To obtain the point of intersection of the second cable, draw the line $K_4 B_4$ parallel to A O; through the point of intersection with the parabola P_4 draw the line $P_4 A_4$ parallel to A E, then project the length $B_4 B_3$ on to the line $K_4 R_4$. From B_3^1 draw a line parallel to the diagonal $A_4 R_4$ to intersect $A_4 P_4$ in K_3^1. The line $K_3 B_3$ drawn through K_3^1 parallel to E R gives the point of connection K_3 of the second intermediate cable. By continuing this construction the remaining points of connection K_2 and K_1 are found.

The unsymmetrical arrangement of the points of connection obtained, shows that it is not advisable to make use of return cables, all of the same cross-section. To get the most uniform distribution of the points of connection, the cross-sections of the intermediate cables should be made proportional to the lengths of the cables, the end cable being half the cross-section obtained by this rule.

This assumption is made in the second construction on fig. 5, and the cross-sections thus obtained are 150, 300, 450, 600, 750, and 900 × ½ = 2,700 mm²; the points of connection being at 3, 6, 9, 12, 15, and 18 km.

V.—The Influence of the Arrangement of the Points of Connection on the Volume of Copper Required.

We shall now proceed to determine whether, in the case of an unsymmetrical arrangement of the points of connection, a greater economy in copper is secured by crowding the points of connection towards the beginning or towards the end of the line.

Let us consider a line of length, L, to which currents are delivered at n places. To make the investigation as simple as possible, let us assume that there is an end cable and only one intermediate cable, which is connected to the line, at a distance of m currents in one case from the beginning of the line, and in the other case from the end of the line.

The distribution of the currents in the two cases are

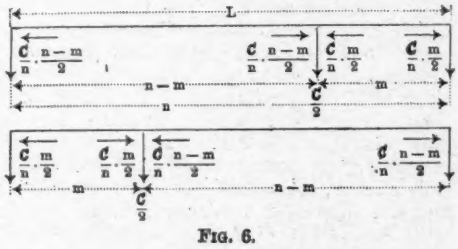


Fig. 6.

evident from the adjacent diagrams (fig. 6). In the first case the current which the intermediate cable takes off is :—

$$C_k = \frac{C}{n} \left\{ \frac{n - m}{2} + \frac{m}{2} \right\} = \frac{C}{2}.$$

The current in the end cable is

$$C_e = \frac{C}{n} \frac{m}{2}.$$

Since the lengths of the cables are $\frac{L}{n}(n - m)$ and L.

$$s_k = \frac{\frac{C}{2} \frac{L}{n} (n - m)}{K \Delta} = \frac{C L (n - m)}{2 n K \Delta}.$$

and

$$s_e = \frac{C L m}{2 n K \Delta}.$$

From these we obtain the volume of copper:

$$v_1 = v_k + v_e = \frac{C L^2 (n-m)^2}{2 n^2 K \Delta} + \frac{C L^2}{2 n K \Delta}$$

$$= \frac{C L^2}{2 n K \Delta} \left\{ \frac{(n-m)^2}{n} + m \right\}.$$

In the second case the current which the intermediate cable draws off is,

$$C_k = \frac{C}{n} \left\{ \frac{m}{2} + \frac{n-m}{2} \right\} = \frac{C}{2}.$$

The current in the end cable is

$$C_e = \frac{C}{n} \cdot \frac{n-m}{2}$$

Since the lengths of the cables are $\frac{L}{n} m$ and L_1 the cross-sections are

$$s_k = \frac{\frac{C}{2} \frac{L}{n} m}{K \Delta} = \frac{C L m}{2 n K \Delta} \text{ and}$$

$$s_e = \frac{\frac{C}{n} \frac{n-m}{2} L}{K \Delta} = \frac{C L (n-m)}{2 n K \Delta}.$$

From these we obtain the volume of copper:

$$v_2 = v_k + v_e = \frac{C L^2 m^2}{2 n^2 K \Delta} + \frac{C L^2 (n-m)}{2 n K \Delta}$$

$$= \frac{C L^2}{2 n K \Delta} \left\{ \frac{m^2}{n} + n - m \right\}.$$

An inspection of the expressions within brackets will show that $v_1 = v_2$.

It is therefore a matter of indifference, as far as economy of copper is concerned, whether cables are connected nearer the beginning or nearer the end of the line. It will be found, by similar reasoning that this result is quite general for any number of intermediate cables.

As an example, let us consider the 18-kilometre line discussed above. Let us assume that besides the end cable, there is an intermediate cable connected in the first place at 15 km., and in the second place at 3 km.

In the first case, the current passing through the intermediate cable will be

$$C_k = \frac{540 - 90}{2} + \frac{90}{2} = 270 \text{ amperes.}$$

The length of the cable is 15,000 m., and therefore the cross-section is

$$s_k = \frac{270 \times 15{,}000}{60 \times 30} = 2{,}250 \text{ mm}^2.$$

The volume is $2{,}250 \times 15 = 33{,}750$ dcm^3.

In the end cable the current is $\frac{90}{2} = 45$ amperes, therefore the cross-section

$$s_e = \frac{45 \times 18{,}000}{60 \times 30} 450 \text{ mm}^2,$$

and the volume $450 \times 18 = 8{,}100$ dcm^3. The total volume is therefore 41,850 dcm^3.

In the second case, the current in the intermediate cable is

$$C_k = \frac{90}{2} + \frac{540 - 90}{2} = 270 \text{ amperes;}$$

the length of the cable 3,000 m., and the cross-section is therefore

$$s_k = \frac{270 \times 3{,}000}{60 \times 30} = 450 \text{ mm}^2.$$

The volume is $450 \times 3 = 1{,}350$ dcm^3.

In the end cable the current is

$$s_e = \frac{225 \times 18{,}000}{60 \times 30} = 2{,}250 \text{ mm}^2,$$

and the volume $2{,}250 \times 18 = 40{,}500$ dcm^3.

The total volume is 41,850 dcm^3, the same as in the first case.

The formula for the volume of copper obtained above, namely,

$$V = \frac{C L^2}{2 n K \Delta} \left\{ \frac{m^2}{n} + n - m \right\},$$

has a minimum when the expression within brackets is a minimum.

If we differentiate this expression with respect to m, and equate the differential coefficient to zero, we get

$$\frac{2 n m}{n^2} - 1 = 0,$$

$$2 m = n, \quad \text{or,} \quad m = \frac{n}{2}.$$

This means that the quantity of copper required is a minimum when the cable is connected to the middle of the line. In this case the intermediate cable takes a current of $\frac{C}{2} = 270$ amperes, and each end cable $\frac{C}{4} = 135$ amperes. The cross-sections are then

$$s_k = \frac{270 \times 9{,}000}{60 \times 30} = 1{,}350 \text{ mm}^2, \text{ and}$$

$$s_e = \frac{135 \times 18{,}000}{60 \times 30} = 1{,}350 \text{ mm}^2.$$

The total volume is

$$v = 1{,}350 \times 90 + 1{,}350 \times 18,$$

$$= 36{,}450 \text{ dcm}^3,$$

that is, considerably smaller than in the unsymmetrical arrangements.

In the unsymmetrical arrangements the maximum potential difference in the rails is 8·4 volts, while when the cable is connected to the middle, it is only 3 volts.

(To be continued.)

BOARD OF TRADE REGULATIONS.

In a recent issue of an esteemed contemporary there appear some interesting notes on the above subject. The writer is of opinion that station engineers have no right to fix the "standard pressure" at the maximum pressure allowed by the Board of Trade. The regulations are perfectly clear upon this point. Regulation A1 states:—"The pressure of a supply delivered to any consumer shall not exceed 250 volts at any pair of terminals, except with the express approval of the Board of Trade, such approval will only be given for special purposes, &c." To this rule there is no exception, and the sooner station engineers learn to fix the standard pressure so as to allow of the 4 per cent. variation without exceeding the maximum, the less trouble they will have when the day of visitation by a Board of Trade inspector arrives. Another note deals with three-wire alternating distributing systems, and says that "Many engineers have considered that a 2 × 220-volt alternating current three-wire system comes within the category of high pressure supply." While, as the writer says, this applies to the distribution it cannot apply to two service cables, one connected to an outer and the other to the middle wire, provided the latter is earthed and that the other outer is not carried into the house.

In referring to Prof. Fleming's report to the Douglas Town Council, some adverse criticism of the Professor's opinions is given, and we are inclined to agree with the writer's remarks. That perfectly satisfactory high voltage incandescent lamps can now be obtained in open market of all reasonable candle-powers is well known, and we think that far too much importance is attached to the 5 c.p. lamp. How many people want these lamps even when they can obtain them? We believe station engineers will agree with us when we say that the demand is very small indeed, and when used they are frequently run two or three in series.

The much discussed question of fire risk and premiums is referred to in a further note. That all the insurance offices ought to reduce the premiums in case of electrically-lighted premises goes without saying, and although bad wiring has resulted in a few cases in an outbreak of fire, it is questionable whether any electric wiring has been half as bad as the gas pipes which are laid in the majority of houses. Small compo pipes kinked and badly jointed, run promiscuously under floors and behind plaster in positions where nails may be most readily driven through them, and are absolutely unpro-

tected, cheap fittings with leaky cocks and badly cut screw threads, to say nothing of the highly dangerous waterseal chandeliers, and the thousand and one other oddments go to make up a system about as dangerous to life as it can well be.

There is no doubt that the ignorance of fire office inspectors in the early days must be held to be largely responsible for the present high rates for insurance. The majority knew little or nothing of the subject of electric lighting and were no doubt afraid of it.

Unfortunately all the chief offices are allied, and consequently to do as our contemporary advises, viz, to refuse to take out a policy with any office which will not make a reduction, would mean ignoring those offices which are financially sound, and possibly insuring in some office whose financial position is problematical. Now that the electric lighting of premises is so popular, we hope that the insurance companies will take the matter into serious consideration, and in common justice reduce the premiums for all properly wired electrically-lighted premises.

THE "LATENT DANGERS" OF ELECTRICITY.

By W. S. HEDLEY, M.D.

During an inquiry recently held before the Bradford city coroner, respecting a case of death from electric shock, the electrical engineer of the Bradford Corporation is reported * to have said that there are "latent dangers" (in electric lighting currents) "not yet fully realised." To me it appears that such a statement is calculated needlessly to alarm and seriously to mislead a certain section of the public. In point of fact the conditions under which electric lighting currents are likely to prove dangerous are fairly well understood; and from the occurrence of such conditions the ordinary user of electric light is securely and efficiently guarded. The witness in question preceded his very disquieting announcement by explaining that the deceased could not have received more than 225 volts, whilst the current was not generally fatal under 1,000 volts. It is not my present purpose to discuss the details of this case, nor to allude to a point which at once suggests itself, viz., that given a voltage of 225, and a three-wire system, and a leakage to earth on one of the outer wires (was this the "latent danger" darkly hinted at in the Bradford circuit?) it is possible to receive a shock at 450 volts.

Leaving this particular instance aside, it might be expected that in any such case an expert witness would explain that factors other than voltage, not less important and equally well understood, enter into the question. It is to intensity of current as measured in ampères rather than to mere voltage that attention may be usefully directed. Of course it is true that, other conditions remaining the same, danger to life increases in direct proportion to the electromotive force. But it is because these "other conditions" vary so widely that the effects of given voltages are so different. The duration of contact, the nature of the contact, its superficial area and position, the condition of the skin, the periodicity of the current, are amongst the chief factors to be reckoned with.

Kratter found that one short application of an alternating current at 1,500 volts did not always kill either rabbits or guinea-pigs. Yet much lower voltages have often proved fatal to man. It may be remembered that in one of the exhibitions at Kensington (the Fisheries?) a man was killed from a direct current Hochhausen machine, the voltage of which did not exceed 500; and the present writer has on former occasions quoted in the Electrical Review instances in which voltages considerably under 500 have caused death.

With reference to duration of contact, experiment has shown that currents easily borne by an animal when momentarily applied, were fatal when the application was prolonged to 5—10 seconds; and this is exactly what might be expected, for reasons both physical and physiological. It is obvious that the larger and better the contact, the greater the current. The condition of the skin with reference to moisture, or any breach in its continuity, comes to be a point of the highest importance, inasmuch as the epidermis is the great insulator of the body. The diminution of skin resistance (increase of current) by wetting is a familiar fact. This occurs (1) by water, a fairly good conductor, getting into the interstices of the skin; (2) by the formation of a good conducting joint due to a layer of water being interposed between the contact and the skin. The position of contact, *i.e.*, the points of entrance and exit of the current, in other words, the direction of the current's path through the body, is obviously of material consequence; for instance, does the heart lie in the line of greatest current density? Under such various conditions of contact it is not to be wondered at that, with a given E.M.F., the current received and the effects thereof must vary within a very wide range. It would indeed be remarkable were it otherwise.

In this connection it may be remembered that when, a few years ago, it was proposed to raise the limit of low pressure supply, a conference on the subject was held, under the auspices of the Board of Trade, and discussion was invited. On that occasion it was claimed by several of those present that they had received harmless shocks from what were then considered to be high pressure circuits. One gentleman asserted that he had felt no ill-effects from a 600-volt shock. The present writer, commenting upon this at the time, wrote as follows *:—

"In view of the fact that so much depends upon contact and the manner of taking a shock, and that little or no information was given on this point, it is difficult to form an opinion from such a statement. Did the gentleman in question touch one pole only of a 600-volt circuit? If so, what was the earth insulation of the other pole? Was his body in contact with the earth? Or, presuming that he simultaneously placed one hand on each pole of the 600-volt circuit—what was the surface area of skin contact, and what the condition of the skin? In the absence of information on such points, the statement referred to cannot be considered to have any real value. Had the surface area and condition of the skin been favourable for a low resistance contact, it is more than possible that the gentleman in question might ere this have been 'put to earth' in a sense other than an electrical one."

It is scarcely necessary to add that, had such a catastrophe unhappily occurred, its explanation might better have been sought in Ohm's law than in the shadowy hypothesis of "latent danger."

* *Westminster Gazette.*

ACCUMULATORS AND VEHICLES.

The question must be very prominent in the minds of many as to whether electric accumulators are of the slightest use for the propulsion of vehicles. It is true that motor cars which depend upon accumulators make an occasional brave show in the streets of London; and one following in the wake speedily realises the difference betwen that and an oil car. But the prevailing notion is that accumulators are more or less experimental, and that we may have to wait some time before we obtain a really practicable electric motor vehicle. Although we cannot wholly coincide with such a view, there is, judging from recent experience, a certain amount of reason in that attitude. The performances of the London Electric Cab Company and the Electric Omnibus Company have done much harm to electrically-propelled vehicles of the self-contained type. The first-named concern was brought on to the market with a great blare of trumpets, and the public rapidly, if not eagerly, took up the venture. Electrically and commercially it was unsound, and the criticisms which were advanced at that time have been amply verified. It is quite true that an elaborate series of experiments were conducted by the engineers of the concern, and we firmly believe that a good deal of valuable information was thus obtained. But so far from the Cab Company benefitting from the experience which they obtained in this manner, and, selecting the best types of cell, they seemingly took up a cell which, according to their own tests, was quite inadequate to the needs of a cab service. Presumably, the

* "Current from the Main," by W. S. Hedley, M.D., (Lewis).

reasons that led the directors to adopt this accumulator were the somewhat handsome terms for maintenance offered by the accumulator company. Whatever the reasons may have been, it is said that the conditions of maintenance were not fulfilled, and with the absolute failure of the accumulators it was only a matter of time before the cabs were taken off the streets. An inquiry into the exact circumstances surrounding the flotation of this company would probably reveal some very disagreeable features. We do not for the moment propose to enter into such an investigation, but it should not be overlooked that this company paid for a form of gearing more or less valuable, practically £21,000, and on the top of that it entered into an agreement to pay a royalty of £4 per cab for the use of a controlling device. Without an accumulator all these patents, for which such handsome sums had been paid, were not able to be brought into practical operation. The Omnibus Company, which was formed to propel 'buses by electricity, had a protracted but inglorious existence, and it is doubtful if this concern, in the whole of its somewhat lengthy life, has left any data that can be of real value in future work. The disastrous results that have attended these schemes are likely to have very material influence upon future attempts to introduce electric cabs; and yet it would be exceedingly unfortunate both for the public and the electrical industry if any really sound concern were to meet with no support on account of former failures. The investing public, however, has a long memory, and it is certain that any scheme which pays heavily for patent rights, and is thus under the necessity of providing a large capital will meet with very little support. In Paris and America, particularly in the latter, a certain degree of success has attended the efforts to introduce a public service of electrically-propelled vehicles, and even within our own shores some of the most important and far-reaching results have been obtained in accumulator traction. We refer to the electric line at Birmingham, and though it is more or less an open secret that the maintenance figures obtained are most remarkable, there is, for some reason or other, a difficulty in persuading the owners of the system to publish actual results. This is particularly unfortunate, because this line is commonly credited with being the most expensive electric line in this country, or probably the world. Whatever may be the ultimate outcome of the New York electric cab service it seems that, financially and electrically, notable success has been achieved. Curiously enough, the commencement of the service in New York was almost contemporaneous with that of London. Probably the first efforts of the New York people were a little more modest than ours, for they started with 14 vehicles, and this has been gradually increased to 200 in actual operation. Later reports show that something like 2,000 vehicles are being constructed to operate in New York alone. Although one cannot attach much significance to financial operations, it is certainly worth mentioning that shares which cost £20 in 1897 now stand at £97. But what is of paramount importance to all interested in electrically-operated vehicles is the fact that a dividend of 8 per cent. has been paid on the preference, and a dividend of 2 per cent. on the ordinary shares. Surely if it is possible for an electric cab company to be electrically and financially successful in a city like New York, which is notoriously badly paved, how much better should such a service be in London. When we consider these figures one cannot help feeling indignant that there has been so much wasted effort in this country. It is extremely probable that attempts may be made in London during the next few months to start a new electric car service, and if that is the case, we would offer a word of advice to the promotors:—"Do not suggest anything that will involve a large capital outlay, keep down the vendor's price, and be sure of a satisfactory accumulator before making a start." Unless these conditions are met, we may be sure that any new attempt to start electric vehicles will receive but scant consideration.

GREENOCK ELECTRICITY WORKS.

The new municipal station at Greenock was formally opened on Thursday last week, the current being switched on by Mrs. Cameron, wife of Bailie Cameron, convener of the Electricity Committee.

In an introductory speech, Bailie Cameron stated that the Corporation obtained a provisional order as early as 1888, but did nothing with it. A small committee was appointed about three years ago, urged on by the applications of two private companies for powers, but even then nothing was done until the Board of Trade threatened to admit a company.

About a year ago, acting on a report by Mr. Teague, of Paisley, the Corporation took proceedings towards erecting a supply station, and appointed Mr. S. E. Fedden, electrical engineer, who pressed on the work so rapidly that it was practically ready for the opening in seven months and ten days from the commencement of operations, a period said to be the shortest on record. Already applications for 3,000 glow lamps have been received, while there are 44 arc lamps in use for street lighting. The plant consists of two 60-KW. Silvertown dynamos coupled tandem to a Belliss two-crank compound engine, and one 180-KW. dynamo coupled to a three-crank engine, while a similar 180-KW. set is about to be put down. The boilers are of the Babcock-Wilcox type, two in number, with provision for four more, and there is a battery of 304 Tudor cells. The whole of the mains were laid by the Callender Cable and Construction Company, while the India-rubber, Gutta-percha and Telegraph Works Company were the principal contractors, and supplied the generating plant, switchboard, &c.

The Corporation has instituted an exhibition of electrical apparatus near the works, which was opened on the same day.

In the evening the Provost, Magistrates, Town Council, and a number of visitors were entertained at a dinner given by the contractors, at which Mr. W. E. Gray, of the Silvertown Works, presided. The usual toasts were honoured and a number of interesting speeches were delivered. Provost Wood, of Partick, described the difficulties with which his Council was contending in connection with the proposed electricity works; the trouble is due to the dust destructor with which the station is to be burdened *à la* Shoreditch. The Provost remarked that even if Partick is some day swallowed up by Glasgow, Mr. Chamen would be sure to want a generating station in Partick. In reply, Mr. Chamen raised no objection to inheriting the station if it was like the one at Greenock, which he most cordially approved of; but as for the destructor—words evidently failed him! He had been to Shoreditch, and seen the coal heaps in the boiler house, which he was informed were drawn upon every night. Even a dead donkey had been destroyed there, but this class of fuel could not be relied upon in Glasgow, though there were plenty of donkeys there who ought to be dead.

Mr. Bryson, of Leith, whose station was equipped by the same contractors, agreed with Mr. Chamen both with regard to the excellence of their work and on the subject of dust destructors.

In toasting the contractors, Bailie Cameron remarked that the fulfilment of the contracts exceeded the promises made, and the time originally fixed for opening the station had not yet arrived. There had been no disputes or misunderstandings whatever. Messrs. Gray and Callender feelingly acknowledged the compliments, the latter remarking that he was unaccustomed to them, while both expressed their admiration of Mr. Fedden's energy and skill. Mr. Best, who carried out the work for the Silvertown Company, came in for a good share of praise, which all who are acquainted with him know to be well merited. The company broke up at a late hour, after spending a most enjoyable evening.

CORRESPONDENCE.

Signalling Without Contact.

I must thank Mr. Pigg for his very kind and appreciative remarks, which, coming from a gentleman who has made so special a study of his subject as the author of "Railway Block Signalling," are particularly gratifying.

Mr. Pigg's only adverse criticism is due to an extraordinary oversight in my paper, for pointing out which I am much obliged to him. The switch levers in the signal-box would necessarily have to be interlocked with each other and with the point levers, as all signal levers are now. All existing interlocking frames can be made use of without any alteration whatever; it is only necessary to fix suitable insulated contacts on the present levers, or, as was done at New Southgate, to actuate independent switches by the levers. This point is referred to in my letter in your issue of November 24th, and in an article on "The Fog Signalling Problem," that appeared in *Transport* on November 17th. For new work the interlocking might be either electrical or purely mechanical, as preferred.

"C. M. J." really is not fair; in his first letter he set forth numerous criticisms and questions with which I carefully dealt in my reply, and I asked in turn a few questions, to not one of which has he vouchsafed an answer. I, therefore, again ask: (1) In the absence of fogger and detonators, how does a driver discover that he is passing an invisible signal? (2) If he invariably knows when he is passing an invisible signal, of what use are the detonators? (3) If he cannot tell without the aid of the detonators what course is open to him but to go on moving until detonators are heard, or, as "C. M J." puts it, to "assume that the line is clear if he does not hear a detonator explosion"? (4) What bearing has praise of an old method, uttered before the appearance of a new method, as criticism on the said new method? (5) Why is it easier to read signals on the road than on the engine? (6) Where are trains to be seen running through four block sections per minute?

Now as to the 30 "indications and road numbers" per minute. I cannot admit that counting up the separate details of a signal gives a fair criterion of the work to be done in reading the signal, any more than the number of letters in a word is a gauge of the time needed to identify it. In either case the complete picture impresses itself on the eye as a whole, and when well known is identified in a flash. Independently of this consideration 30 per minute is something like double the possible. Suppose a train passing through one block section with four signalling positions per minute, and that at each position a double number is taken, there will thus be eight road numbers and eight semaphore indications, or 16 "letters," forming four "words" or pictures of great simplicity per minute.

I can assure "C. M. J." that I have not the very slightest "objection to the quotation from Sir George Findlay;" but if "the great improvements in that system" (the use of detonators) "that of late have taken place" have, as seems to be inferred by "C. M. J.," taken place subsequently to the publication of Sir G. Findlay's praise, *why* were they introduced after the system had been blessed in its former state?

It now appears that it is not an electrician but a teacher from an infant school that will have to travel on an engine fitted with my apparatus to tell the driver (literally in the case instanced) that two and two make four, and to point out that two spots are in the habit of changing colour both together from green to red and back, or, in the just possible case of a circuit failing, that they are standing fixed—one green and the other red. Experienced engine drivers have told me that they would be thankful to have my apparatus on their engines, but they have never asked for the infant school teacher.

Now as to signals on the engine taking the driver's attention off the road. I know that this is feared by some engineers, but until experience has been had, the matter is confined to conjecture. To me, it certainly appears that signals given always in the same spot on the engine and notified by a bell will monopolise far less of the driver's time than signals that he has, in all kinds of weather, to look for high up in the air and pick out from large numbers of other similar signals disposed round about.

"C. M. J." is, of course, as much entitled to his opinion as to the best plan of indicating signals as I am to mine. I am sorry I have not converted him, as I thought the back-view indicator would have met the case. The plan seems to me so straightforward and clear; every "stop" signal off is permission to go over the *whole* of the block section beyond, but no further. If you are free to go further at the time you pass the distant signal for the next section, then you are then positively told so; otherwise, you prepare to stop at the end of the section you are on.

If a wrong road number is given, whether through the default of the signalman or that of the apparatus, the driver, of course, as pointed out in my last letter, slows down and whistles for the right one. To give the number looked for in conjunction with the wrong road would need a mistake on the part of the signalman and a failure of the apparatus *at the same time*.

In regard to single line working, I must repeat that I propose to operate the danger magnets entirely in duplicate with a current indicator on each circuit. "C. M. J.'s" final question—"How can the switches that would be required for throwing these electro-magnets 'in' and 'out' be safely and efficiently controlled?"—is, coming as it does at the end of his second letter on a system based on the continual manipulation of such switches, to say the least of it, somewhat astonishing! Does "C. M. J." think that a danger magnet must be equal to the field magnet of a good-sized dynamo? As a matter of fact, the loss in each coil need not be as much as $\frac{1}{10}$th of a watt, or, the current equal to that rapidly made and broken in a small trembling bell.

In conclusion, I may say that I am glad to find that "C. M. J." can call anything of mine—even equations—simple. It would have been more in accord with the rest of his letter to have written M^2 for M_2, and called the equation quadratic!

W. S. Boult.

December 2nd, 1899.

Electric Cranes.

In the first instalment of the very interesting article on "Electric Cranes" which appeared in the issue of the Review for November 17th, a three-motor crane, built by Messrs. Carrick & Ritchie, is described and illustrated.

Assuming that the hoisting and cross-traversing motors are reversed by the liquid resistances, it is difficult to see how the four cross wires are sufficient to make the necessary connections to both motors. The usual practice appears to be to fit seven or eight cross wires, according to whether the electrical brake is series or shunt wound, and if some of these wires can be dispensed with, it would be of great value to know the method of doing so.

Would the able writer of the article in question explain how the trick is done in the crane he describes?

H. W. W. D.

[We are sorry to disappoint our correspondent; but, of course, the statement referred to was a slip, and *seven* wires were used, three of them being hidden by the others.—Eds. Elec. Rev.]

Tested Lamps.

I have read with interest your correspondent's letter under the above head in your last issue. Having had a large experience with lamps, I think that I might safely give you a few of my results.

I have found that some firms can make a very good 100-volt lamp, whilst their 200-volt lamp is by no means so satisfactory.

To obtain a parallel curve between the 100 and 200-volt lamps it would take a good deal more than a ·7 increase on the watts per candle of the former. In many of the lamps that I have tested I have found that the current rises as the lamp burns, a fact that I cannot account for, unless it is that the gas which is left in the bulb, owing to it being at a very low pressure, only gradually deposits on the filament.

In testing lamps of various makes I have not selected those of the same efficiency, but taken them as they came and run them for a certain number of hours. I found that the most efficient lamps were not necessarily English.

I have been told that the Tested Lamp Company supply many different makes. This being so, your correspondent's suggestion cannot hold.

F. P. S.,
Electrical Engineer.

December 4th, 1899.

In your current issue, a correspondent signing himself "English Electric Engineer," quotes the name of the above

company as having given you vague and unsuitable information. Permit me to say that this must be a mistake, as no information, vague or explicit, has been supplied to you by any official of this company.

Your correspondent misquotes an article which appeared in the *Electrical Engineer* of November 3rd, and makes other erroneous statements which it is no part of the duty of this company to correct.

The writer of the article in the *Electrical Engineer*, whom your correspondent accuses of making "absurd" statements, is an engineer of some distinction, and fully capable of making an adequate reply to your correspondent should he consider any commentary necessary.

Finally, it is asked whether "the Electric Tested Lamp Company is an agency for an American or Continental lamp?" As this last paragraph verges on the libellous, I must ask you to publish my statements: (1) That the company in question is in no way connected with any lamp manufacturer, English, American, or Continental. (2) That at least 95 per cent. of the company's business is in English goods of various makes.

You will greatly oblige me by publishing this letter, and should you care to go further into the matter, I shall at all times be glad to furnish you will any information at my disposal.

A. W. Gattie,
Managing Director
The Electric "Tested Lamp" Company, Limited.

London, *December 4th*, 1899.

The Influence of Cheap Fuel on the Cost of Electrical Energy.

In reference to your remarks on my paper, there is one point in which you are liable to mislead your readers. When you refer to the figures given at the end of my paper, which represent the actual cost of power at our Chelmsford works power station, you talk about them as optimistic, and then proceed to compare them with results obtained at Manchester and elsewhere. I would first remind you that the figures furnished in my paper are an actual copy of the log sheet for the 49 weeks immediately preceding the writing of my paper, and represent very accurately the actual results obtainable from a modern power station which supplies power for a modern engineering works. The sole reason why they are better than the figures for Manchester, Bradford, and Leeds, or other lighting power stations, is that naturally the load factor of an engineering shop is an extremely good one, and that there are, of course, no distribution costs or losses to be included.

As regards the question of bituminous coals, which you state receive tardy recognition, I think you will find that engineers of power stations have for many years past undoubtedly been attempting to utilise the high calorific value of bituminous fuels. It is the extreme difficulty of doing this which has prevented any great progress being made. It has been found in practice that it is an extremely difficult matter to prevent visible smoke being from time to time produced by furnaces burning bituminous fuel, and one of the objects of my paper was to call strong attention to this fact, and to the desirability of attention being paid to the perfecting of the combustion chambers, which are absolutely necessary if we are to satisfactorily attain this object.

R. E. Crompton.

An Electrical Supply Question.

In reply to the question in your issue of the 1st inst. *re* above, I think "Supply Company" will find that a company or Corporation are compelled by Act of Parliament to give a supply to all applicants within the township or boundary—whether the applicants have a private supply of current, or otherwise, providing they comply with the conditions of supply.

Zero.

[We refer to this question in our leader pages this week.—Eds. Elec. Rev.]

Three-Wire System of Distribution.

In stating the advantage gained as regards saving in copper by substituting a three-wire for a two-wire system, it is argued, where a conversion of the kind is under consideration, that the capacity of the mains would be increased fourfold; and in your leader of the 24th ult. you state, when comparing the two systems, that the weight of copper is reduced in the ratio 16:5. Surely this works out at 8:5 in transmitting *the same energy for the same distance*, for the sectional area of two mains is halved, whilst a third is added having a sectional area equal to one-eighth of their total. Of course, for the *same percentage drop in potential* the ratio 16:5 is correct, but then for the same distance double the energy is transmitted; therefore it would seem fairer to the three-wire system if, in comparing its advantages as regards mains with the two-wire arrangement, the saving in copper were always spoken of as five to eight.

I.

[This matter has been explained again and again. In comparing two systems of electrical transmission of power, the *efficiency* must be the same in both; if not, the result can be made whatever one pleases. This condition being fulfilled, the three-wire system transmits *the same energy* for *the same distance* with from $\frac{5}{16}$ths to $\frac{6}{16}$ths of the copper required by the two-wire system.—Eds. Elec. Rev.]

BUSINESS NOTICES, &c.

Electric Tramway Lists.—The publishers of the Electrical Review have had a number of copies of the "List of Electric Tramways and Railways in the United Kingdom," which accompanied our last issue, mounted on linen, and these can be obtained at 1s. per copy, or 1s. 3d. post free.

Electrical Wares Exported.

Week ending Dec. 6th, 1898.

Adelaide	Value £55
Barcelona	115
Bombay	110
„ Teleph. mat.	42
Boulogne	109
Buenos Ayres	1,427
Calcutta	1,775
Cape Town	339
Christiania	54
Cienfuegos. Teleg. cable ..	197
Durban	176
„ Teleg. mat.	72
East London	254
Ghent	33
Gibraltar	94
„ Teleg. mat.	750
Hobart	20
North Atlantic. Teleg. cable ..	1,000
Port Elizabeth	330
Shanghai	185
Singapore. Sub. Teleg. cable ..	192
Sydney	1,130
„ Teleg. mat.	16
Trinidad	26
Wellington	179
„ Teleg. mat. ..	1,287
Total ..	£19,317

Week ending Dec. 5th, 1899.

Alexandria	Value £570
„ Teleg. mat. ..	51
Amsterdam	50
Bangkok	128
Beira. Teleg. instruments ..	48
Bilbao	56
Boca. Teleg. mat.	222
Bombay	16
Boulogne	70
Brisbane	265
„ Teleg. mat.	649
Buenos Ayres	245
„ Teleg. mat.	118
Calcutta	705
„ Teleg. wire	47
Cape Town	209
Chinde. Teleg. mat.	941
Colombo	38
Durban	1,722
East London	50
Fremantle	13
Hamburg	330
Hong Kong. Teleg. wire ..	82
Madras	91
Malta	143
Mauritius	23
Melbourne	427
Montreal	116
Novorossisk	80
Ostend	118
Perth	93
Port Elizabeth	85
Port Said	366
Rotterdam	930
Santos	62
Shanghai	530
Singapore	84
Stockholm. 63 T. teleg. wire .. (Value not declared)	
„ Sydney	1,144
Yokohama	400
Total ..	£11,257

Foreign Goods Transhipped.

Brisbane. Telephone	44
Rotterdam	35
Total	£79

Buenos Ayres. Elec. mat. ..	43
„ Teleph. mat. ..	90
Flushing. Elec. goods	80
Perth. Elec. motors	967
Total ..	£1,130

Appeal Case—Stegmann v. O'Connor.—In the Court of Appeal on Thursday, December 7th, Lords Justices A. L. Smith, Henn Collins, and Vaughan Williams on the Bench, judgment was given in the case of Stegmann *v.* O'Connor, which was argued before their Lordships on November 16th. This was the appeal of the plaintiff, Mr. Stegmann, an electrical engineer, from the judgment of a Divisional Court, composed of Justices Bruce and Ridley, on February 18th of this year, confirming a decision of the Official Referee, who had awarded the plaintiff £50 on a counterclaim as being a penalty of the liquidated damages provided for by a contract for an electric lighting installation at defendant's house, "Mount Cashel," Nightingale Lane, Clapham. Mr. Tindal Atkinson appeared for the appellant (the plaintiff in the original action), and Mr. Clavell Salter for the respondent

(the defendant in the action). Lord Justice Collins read the judgment of himself and Lord Justice Smith. They were of opinion that the plaintiff was certainly liable for not less than £50, liquidated damages on the facts of the case, and that the appeal, therefore, should be dismissed with costs. Lord Justice Vaughan Williams dissented. After quoting several authorities, his Lordship said it seemed to his mind clear on the findings and figures of the Referee that he had given the proprietor the liquidated damages for the time after the exclusion of the engineer from doing the work. That, to his mind, was clearly wrong, and he thought the case should go back to the Official Referee to find whether the proprietor, by his conduct, had disentitled himself to claim, and so that it might be determined whether the facts were such as to make the plaintiff chargeable for the delay during the time preceding the exclusion of the engineer. It did not seem to his Lordship that the case could be satisfactorily disposed of without reference back. On the finding of the majority of the Court, the appeal was dismissed with costs.

Auer's New Incandescent Electric Lamp.—Under the heading, "A Windfall for Welsbach," the *Westminster Gazette* says:—

We are able to make an important announcement as to the great Welsbach Company. At the last meeting much was made of Dr. Auer's new incandescent electric lamp. It is claimed for this lamp, it may be remembered, that it will do for the electric light what the incandescent system has done for gas; that it cheapens the light by more than half; that the Welsbach incandescent electric lamp will give four times the light of the ordinary incandescent lamp. One new point is that the new lamp is now perfected, Dr. Auer having just gone to Berlin to give its manufacture his final supervision. New premises have been erected by Messrs. Pintsch for the manufacture of the lamp in all sizes, and it is expected that it will be ready for introduction into this country early in the new year. Another new point is as to the financing of this latest lamp. We are given to understand that according to the arrangement between the Welsbach Company and the inventor it will by no means involve any new capital expenditure; on the contrary, it will mean a windfall for the Welsbach shareholders. The Welsbach Company owns three-sevenths of the patent rights throughout the world, and this, it is estimated, represents in value about £2,000,000 sterling. According to present arrangements the Welsbach Company will not work its rights, but will immediately dispose of them, which, if half the hopes are realised, will, as we have said, mean a handsome windfall for the company and its shareholders.

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court, held on Wednesday before Mr. Registrar Giffard, Frederick George William Adams, electrical engineer, lately carrying on business in partnership as Downie & Adams, at 24, Newman Street, Oxford Street, W., attended for his public examination. He has filed accounts showing unsecured debts £1,000, contingent liabilities £2,142 7s. 9d. (not expected to rank); and assets consisting of shares in the Premier Electricity Meter Company, Limited, value not stated. In the course of his evidence the debtor stated that he and a partner in February, 1897 (with £1,000 capital provided by himself) commenced business as electrical engineers, at Bush Lane House, Bush Lane, Cannon Street, E.C. In June, 1897, they removed to No. 24, Newman Street, Oxford Street, W. In January last, in consequence of differences between them, his partner ceased to attend to the business, and in the following July the lease of the premises was surrendered and witness abandoned the business. He had previously handed a large part of the stock to creditors who were pressing, and sold other stock, at much less than cost, to a relative for £180, which sum was paid to pressing creditors, whilst the fixtures and the remainder of the stock (of small value) were left on the premises, against rent due. He had been without occupation since July last, and is dependent on a relative. In March, 1898, he and his late partner, together with another person, promoted the Premier Electricity Meter Company, Limited, (with a nominal capital of £25,000 in £5 shares) to which the firm assigned a license which they held for the working in the United Kingdom and the Colonies of two letters patent for improvements in electric meters, and known as the Brillié patents, in consideration of £20,000, payable in shares, half of which were to be handed to their associate for his services in connection with the promotion of the company, and for raising working capital. The company also agreed to take over 50 meters made under the patents, and all fittings, instruments, &c., used in the testing and the sale of the meters, at the price of £500 payable in cash, but only £250 thereof was received by the firm. He attributed his failure and insolvency to loss on the capital contributed by him to the partnership, in consequence of bad debts and other causes. The examination was ordered to be concluded.

A receiving order has been made against H. L. Howard (Thompson, Howard & Co., Harrogate and Hull), electrical and mechanical engineer.

Liquidations, Dissolutions, &c. — The Electropathic and Turkish Baths, Limited, is winding up voluntarily. Mr W. R. Waller, 3, Bucklersbury, E.C., is liquidator. Creditors are to send particulars of debts, &c., by January 6th. Shareholders will meet on January 15th to hear an account of the winding up.

F. H. Cerrito, A. E. A. Edwards, and W. Shaw (Cerrito, Edwards and Shaw, consulting, mechanical and electrical engineers, Birmingham) have dissolved partnership. Messrs. Edwards & Shaw will continue in partnership at 105, Colmore Row, and Mr. Cerrito will carry on business at 39, Newhall Street, Birmingham.

A meeting of the London and Hampstead Battery Company, Limited, will be held at Donington House, Norfolk Street, W.C., on Friday, January 5th, to hear an account of the winding up from the liquidators, Messrs. R. J. S. Beeton and S. T. Turtle.

Books Received.—"Fire Tests with Ceilings." A ceiling constructed with slag wool, by D. Anderson & Son, Limited, London, and J. C. Broadbent & Co., Limited, London. London: The British Fire Prevention Committee. 2s. 6d net.

"Central Station Electricity Supply," by Albert Gay, and C. H. Yeaman. London: Whittaker & Co., 1899. 10s. 6d.

"The Gold Fields of Victoria." Monthly Return, August, 1899. Issued by James Travis, acting Secretary for Mines, under the authority of the Hon. Henry Foster, M.P., Minister of Mines.

"Victoria, its Mines and Minerals." Special edition (English) of the *Australian Mining Standard*. June 1st, 1899. Melbourne and Sydney: F. Critchley Parker. 1s. 6d.

The Copper Market in November.—Messrs. H. R. Merton & Co.'s last statistical return shows that during November the supplies of copper have totalled 18,650 tons, as against 18,821 tons delivered. Stocks would, therefore, have suffered only a slight diminution had not 868 tons of Standard copper been re-shipped to America. This increases the fall in stocks to 1,039 tons; and the movement in price from £72 17s. 6d. on October 31st, to £73s. 15s. on November 30th, is due chiefly to this cause.

The supplies during the second half of November made up for the shortage visible during the first half of the month; and the total of 18,650 tons is about equal to the average for the preceding 12 months. It is interesting to note that the supplies from North America have undergone considerable increase in November, and are above the average for the year. The monthly totals since July 1st are given below:—

July	7,457 tons.
August	8,150 tons.
September	8,407 tons.
October	8,135 tons.
November	10,791 tons.

Whether this increase in the shipments from New York to Europe will be maintained remains to be seen. The November increase, however, lends support to the opinion held by many, that the 8,513 tons of Standard copper which since July have been shipped to New York, will, after electrolytic refining, be returned to the European market. The supplies from Spain and Portugal, and from "other countries" during November are disappointing, the total in each case being considerably below the average; and it would be instructive to have for comparison the shipments direct from these producing countries to New York. The supplies from Chili and from Australia are about the usual figure. The latter country has not shown that increase in production during 1899, which the figures for 1898 had led one to expect.

No new copper mining companies have been floated in London during November. Mr. Alfred Beit is, however, said to be promoting a company for working the Otavi copper mines in South-West Africa. These mines are to be exploited in connection with a railway scheme in the same district. Until the present war is over, and the situation politically quiescent, it is, however, improbable that any copper mining developments in South Africa will occur.

Mr. J. Plummer, writing to the *Engineer* under date November 10th, has given some interesting details of the copper mining industry in New South Wales. The Great Cobar mine is 550 miles west of Sydney, and was reopened in 1894. In 1895 it produced 1,703 tons copper; in 1896, 2,650 tons; and in 1897, 2,462 tons. The production of the smaller mines in 1897 was as follows:—Nymagee, 543 tons; Burraga, 727 tons; Mount Hope, 110 tons; South Mount Hope, 110 tons; Girilambone, 733 tons. Inadequate railway communication hinders development, but this is being remedied.

According to the *Toronto Globe*, native copper has been found upon the shores of Black Bay in shot-like particles, and samples of the conglomerate beds have assayed 2—2½ per cent. copper. If this discovery is confirmed a company will no doubt be promoted to work these deposits. The "Superior Gold and Copper Company" are the present owners of the claim.

Leading articles upon the position of copper have recently appeared in the *Investor's Guardian* and the *Financial Times*.* These deal with a pamphlet recently published, of which Messrs. Brown and Turnbull are the joint authors. The statistics of copper from 1801—1898 have been industriously compiled and presented in this pamphlet. The authors take a distinctly gloomy view of the situation, and consider that sooner or later there will be a "famine in copper." The writers of the articles named combat this opinion, and hold that supplies will increase, and that they will probably keep pace with the demand.

According to the *Financial Times*, the 10 months' consumption statistics of copper show a decline of 22¼ per cent. in England; of 10⅝ per cent. in Germany; and of 1⅞ per cent. in France. If this falling away in consumption is permanent, and indicates the substitution of other metals for copper, the capacity of the producing mines will not, therefore, be greatly strained in "keeping pace with the demand." Possibly Messrs. Brown and Turnbull are not entirely disinterested in predicting a coming famine in copper.

With reference to the future prospects of the Amalgamated Copper Company, the following extract from the *Financial Times*, of November 7th, is of interest:—

The decline of the Amalgamated Company's shares to $96 is a tolerably good indication of the average American's opinion of the chances of the concern, and the decision to cease issuing reports of the Anaconda Company will not be a cause of strength either in the United States or in Europe, nor will the official announcement by the Exploration Company that in consequence of this decision not to publish accounts they have resigned their appointment as the European agents to the company. On the other side there has of late been a prodigious decline in the values of the best copper shares, such as Calumet and Heclas, Boston and Montanas, Quincys and Tamaracks, which are excellent investments in normal circumstances; lake copper has gone back to 17c. per pound; and, as Messrs. James Lewis & Son remind us, the Americans are pressing the sale of electrolytic copper at lower quotations. "Every indication in this country," writes an American correspondent of the *Pall Mall Gazette*, "points to a steady decline" in copper shares—a decline, that is, not from the highest points reached in the spring, but from those at present ruling.

The Corporation of Cardiff v. Ferranti.—Before Mr. Justice Bigham, in the Queen's Bench Division on 1st inst., Mr. Leslie applied that the case of the Corporation of Cardiff *v.* Ferranti should

* *Investor's Guardian*, November 18th; *Financial Times*, November 7th, 14th and 20th.

not be taken until Wednesday, while keeping its place in the list. Counsel stated that there were some 20 or 30 witnesses. His Lordship granted the application.

Catalogues and Lists.—From Messrs. Witting Bros., of Cannon Street, we have received a copy of their new illustrated traction brochure in which they describe their standard motor for electric tramway and railway work. Efficiency, torque, and speed curves are given. Their series-parallel controllers are also detailed in the list. The motors, &c., mentioned, are made at the works of the Electricité and Hydraulique, Société Anonyme, at Charleroi, Belgium, and Jeumont, France.

Messrs. R. A. Broadhurst & Co., of Tottenham Court Road, send us one of their trade list of measuring instruments, switches, fuse-boards and accessories.

From Messrs. Thomas Parker, Limited, we have received a brochure in which a description of the Bootle Corporation Electricity Supply Works is given, it being accompanied by a number of first-class photographic views of the works and plant. A reprint is also given from an engineering journal of a descriptive account of Messrs. Parker's works and specialities. The general get-up of this brochure is excellent.

The Charge of Stealing Electricity.—At the West London Court on 29th ult., A. J. Harrison, electrical engineer, surrendered to his bail, to further answer the charge of stealing electricity from the mains of the Hammersmith Vestry. Additional evidence was given showing that he had a dispute with Mrs. Thomas, who let him some rooms at 262B, King Street, Hammersmith, and made an arrangement for other lights. Wires were fixed, and according to Mrs. Thomas the prisoner caused considerable damage. After the dispute she locked him out.—In cross-examination Mrs. Thomas denied having made any arrangement with the prisoner to take the electric light from the wires, though she believed he was taking it.—Rose Brady, the servant, deposed to the prisoner stating that he was taking the electric light from the main.—Mr. Hanson, in his questions to Mr. Bell, the resident engineer, endeavoured to show that the tubing fixed was bent to pass over the fuse affixed to Mrs. Thomas's wires. He also said the electricity was taken from her fuse.—A further remand was granted for the distance to be measured.

Electrical Enterprise in Germany.—It is common knowledge, says the *Financial Times*, that electrical enterprises in Germany have been promoted on a larger scale than in the United Kingdom, but it is not so well known that a check, perhaps only of a temporary character, has been brought about in regard to speculation in these undertakings. In the course of a series of articles now appearing in the *Frankfurter Zeitung* on the subject of the "Money Market and Paper Securities," reference is made to the causes which have led to the assumption by speculators of an attitude of reserve in respect of electrical projects. The German paper states that electricity works have found it extremely more difficult to raise fresh capital, and that the manner in which large orders were previously obtained was coupled with the advantages accruing from a plentiful supply of money at easy rates. For this purpose various trust companies were formed with the object of attracting money by the issue of shares, and of taking up and completely hatching undertakings which were not ripe for the public. As soon, however, as it was found that the enterprises formed for the purpose of utilising electricity would require a longer period for development than that which was assumed with enthusiasm in the initial stages, the speculative element took up a more reserved attitude in relation to the shares, and even the placing of bonds was rendered difficult by the tightening of the money market. As a result, the electricity companies, including the largest, at the present time experience more difficulty in obtaining fresh capital, and the consequence is that they stand aloof from the promotion of new schemes, at all events, until more favourable conditions prevail. Even the construction of electric tramways and power stations is not being carried on with that zeal which was so characteristic some time ago. This is due partly to the monetary troubles already mentioned, but it is largely owing to the fact that the very sanguine expectations from the substitution of electric for horse traction have not been completely fulfilled, especially as the transformation saddles the converted lines with a large amount of dead capital, due to the laying of new rails and the change in rolling stock. It is true that certain extensions in almost every direction are being made, but speculators have practically withdrawn for the time being, from participation in new undertakings, the general opinion being that performance in the case of the numerous existing electrical enterprises should take the place of promise before speculators should again interest themselves in an industry which has received a set-back of some importance.

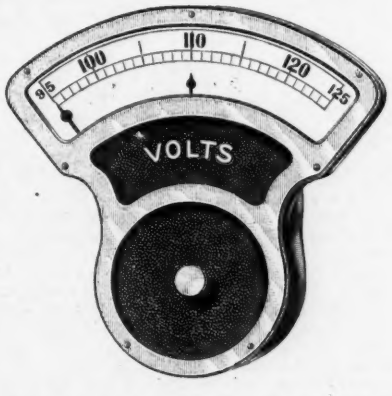
The Hornsby Improved Safety Water-Tube Boiler.—In general form this boiler partakes of the main features of the Babcock & Wilcox type, but it consists of tubes fixed into flat rectangular headers, the upper header being attached in the usual way to the steam drum and the lower header having a short connection to the mud drum by pipes parallel with the main water pipes. The mud drum is then connected by vertical pipes to the steam drum. The mud drum is thus entirely distinct from the header and is by this better fitted to perform the functions indicated by its name. To ensure the steam and water as they enter the steam drum being separated, an annulus of slotted plate is provided and forms a chamber concentric with the shell of the drum, which indeed forms one boundary of the flat annulus. The slots are for the purpose of separating the water and steam; they only occur above water level. Hence the circulating water is delivered above the water level in the drum. The standard pressure adopted by Messrs. Hornsby is 120 lbs. and the boiler is rated by its evaporative power, in terms of 1 H.P. being equivalent to 30 lbs. evaporation per hour. A boiler of 242 H.P. on this basis occupies an area of about 23 feet × 14 feet, has a grate area of 52·60 square feet and two drums 42 inches diameter. The course of the draught is directly up from the furnace amongst the water tubes and after that three more passes are made, the gases finally passing off below the tubes. The down comer pipes to the mud drum are not within the brickwork but fully open to view outside, as also is the mud drum and blow-out elbow pipe. A boiler of 242 rated H.P. is of nearly 32 tons shipping weight and 2,220 cubic feet capacity.

The Institution of Junior Engineers.—At the meeting of this Institution held at the Westminster Palace Hotel on Friday, December 1st, the chairman, Mr. Basil H. Joy, presiding, the paper read was on "Natural Methods for the Purification of Water-carried Sewage," by Mr. G. Drysdale Sweetman, member, of Ryde.

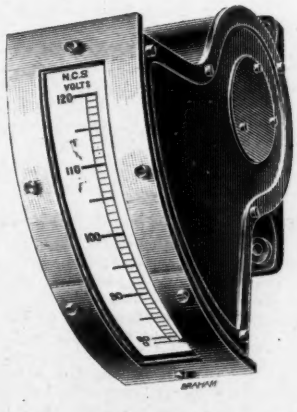
Klein Condensers.—The Klein Engineering Company Limited, have recently received an order from the Liverpool Corporation to erect at their Lister Drive Power Station, a combined condensing and water-cooling plant for engines of 3,600 H.P. The condenser and pumps are of special and improved design recently introduced by the company, and the results obtained will be watched with interest by electrical station engineers. The coolers are of the well-known Klein's patent chimney type. The complete plant will be one of the largest installations of central condensing and cooling plant supplied and erected by British engineers at electricity works in this country.

Light Railways.—The Light Railway Commissioners have asked the Board of Trade to confirm the Essington and Ashmore light railway order; and the Board has confirmed, after modification, the Wick and Lybster, and Doncaster orders.

New Central Station Instruments.—Central station instruments in edgewise and sector shape patterns are now being made by Messrs. Nalder Bros. & Thompson, Limited. The edgewise instruments are made in three sizes, 7 inches, 9 inches, and 12 inches



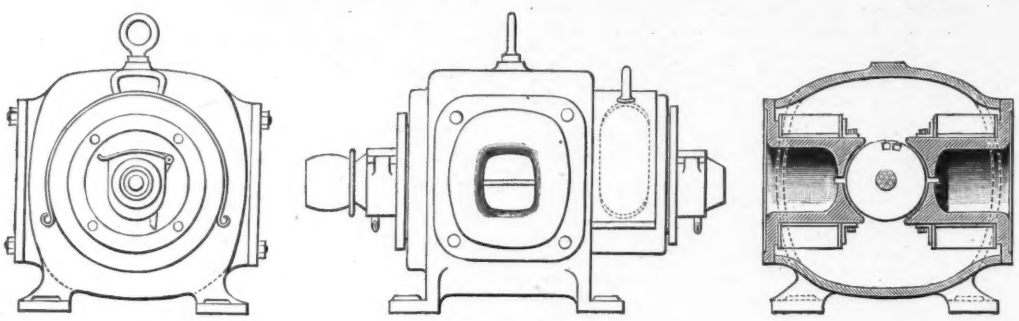
radius, and the two larger sizes can be made with illuminated dials if required. The sector shape instrument illustrated has a scale 12 inches long, the pointer being 9 inches in radius. This instrument is also made with either illuminated or plain dial according to require-



ments. The movements are permanent magnet moving coil dead-beat type in the case where used for continuous current, and for alternating current work the ordinary electro-magnetic movement is supplied. This can be also made with compensation so as to be capable of use on circuits of any periodicity.

New Enclosed Motor.—The illustrations given on next page show the design of a new enclosed direct current motor (the Wilson) which it is claimed embodies special and novel features of construction. The principal difficulty manufacturers of enclosed motors have to contend with, as apart from ordinary open type motors, is in con-

nection with getting rid of the heat generated by the resistance of the armature and field coils, and anything which tends to modify this difficulty may be considered of special utility, inasmuch that the size and cost of manufacture of the machine may be reduced in proportion. As will be seen the motor is constructed with two large hollow field cores, which are made of magnet steel, and for convenience of manufacture and dismemberment are made separate from the body or yoke casting. A large and very effective additional cooling surface is thus provided for the field coils. Another important feature in the design is the provision made for ventilating the



interior of the machine, consisting in slots cut through the pole faces and extending to the outside which allow air of outside temperature to come in immediate contact with the revolving armature, the armature also causing a perceptible current of air to pass quite through the machine. It is stated that the whole design of the motor is of very solid and strong construction, and very large openings are provided for inspecting or adjusting the brush gear, a feature of very considerable importance but often unprovided for. It will also be seen that the motor can be fixed in any position provided the bearings are turned round, and the armature and field coils can be removed without disturbing the foundation fixings of the machine. Perhaps the addition of a horizontal baffle plate in the hollow cores would improve the air circulation.

The O.K. Meter.—The British Thomson-Houston Company, Limited, has issued pamphlet No. 48 which describes type O.K. ampere-hour meter for continuous current circuits only. This meter is constructed for capacities of three amperes and under, while for higher current capacities the Thomson watt-hour meter is recommended. The registering mechanism of the O.K. meter is so adjusted as to read directly in KW.-hours on a usual dial, the volts on the circuit averaging the number stamped on the name-plate. The armature or movable part being made as light as possible, reduces to a minimum the wear on the bearing jewel and pivot. The meter is practically independent of temperature variation, thus insuring the accuracy of the meter regardless of variations of temperature occurring naturally. The cover is arranged in such a manner as to permit of connections being made and sealed without exposing the measuring mechanism. All parts are properly insulated, so that the danger from a ground is entirely eliminated. There is one volt drop due to the instrument resistance with full load, and so the loss of energy from this source is negligible. The motor is claimed to start with 1 per cent. of the full load current or less, thus insuring a high degree of accuracy on the smallest loads (one 5-C.P. lamp) which the instrument is expected to record.

Pedestals.—Messrs. C. Marco & Co., of 4, New Zealand Avenue, make a speciality of carved pedestals made of polished jointed wood. The construction renders them particularly worthy of the attention of electric lighting contractors, as they are ready grooved for wiring. In showrooms of electric light fittings nothing could be handier for displaying standards and bronzes. Even if never sold they would be worth their money as shop fittings.

Railway Rates.—In August last the Railway Companies gave notice in accordance with the latest regulations, that they proposed to classify ammeters and voltmeters for railway rating purposes under class 5. This, it may be mentioned, is the highest classification made for rating purposes. When the fact was advertised abroad opposition was set on foot by the various makers of such instruments, with the result that a deputation (consisting of Mr. Max Byng, of the General Electric Company, Mr. F. H. Nalder, of Nalder Bros. and Thompson, Mr. Vignoles, of Evershed & Vignoles, and Mr. Hamilton, representing Mr. James White), waited upon the Board of Trade on November 24th, and they were successful in getting the instruments mentioned put into class 4—the wording of which is to the effect that electrical instruments for electric lighting and power purposes and telephones are to come under class 4.

Skewes v. Coode and another.—In the Queen's Bench Division of the High Court of Justice on Thursday, November 30th, the Lord Chief Justice and a special jury had before them the case of Skewes *v.* Coode and another, which was an action brought by Mr. Josiah Skewes, of 2, Upper Street, Islington, a chemist and druggist, against Mr. Arthur Coode and Mr. J. E. P. Veale, of St. Austell's, Cornwall, for recovery of £150, being an amount which plaintiff said he had paid to Messrs. Veale & Co., electrical engineers, on application for 150 fully paid-up shares in the company, which had not been allotted to him. Defendants denied that the sum sued for was paid to them, but pleaded that it was paid to their bankers as agents. Mr. Pepys appeared for the plaintiff, and Mr. Willes Chitty for the defendants. Counsel for plaintiff said that his client had applied for 150 shares in the company and forwarded £150 for them, but the shares had never been allotted to him. In October, 1897, plaintiff received a circular from Veale & Co., Limited, in which the name of Mr. Arthur Coode was mentioned. It stated that they had issued shares representing a capital of £10,000, and asked for subscriptions. On October 22nd plaintiff sent in an application for 150 shares, together with a cheque for £150, the money being forwarded as directed in the circular to the Consolidated Bank, Cornwall. After waiting about a month or so, and not having received the shares, plaintiff wrote and withdrew his offer to subscribe. Subsequently, he demanded his money back. It was stated that when plaintiff sent his cheque for £150, the company was indebted to its bankers to the extent of about £1,000; that unsuccessful negotiations took place for a further advance; and that eventually the Cornish Bank advanced £4,000 and became the company's bankers. On December 11th, the account at the bank was closed, and in September of last year the company went into voluntary liquidation. Mr. Pepys, in answer to his Lordship, said he did not allege fraud against the directors of the company; his case was that the plaintiff was entitled to have his money returned, he (plaintiff) having been invited to apply for shares which had not been allotted to him. His Lordship held, after hearing counsel for the defence, that there being no suggestion that the directors could not allot when they issued the circulars, plaintiff could not recover against the present defendants. In the result a juror was withdrawn.

Smoke Persecution.—On Tuesday the Westminster Electric Supply Corporation, Limited, was summoned for on two occasions negligently using furnaces so that smoke therefrom was not effectually consumed. The offences were not denied, and Mr. Iago, the secretary of the corporation, in palliation, urged that the Government had acquired for their transports all the available stock of Welsh smokeless coal. Mr. Horace Smith said he was afraid that was no answer to the summonses. Mr. Percy Gates, for the Vestry, suggested that a more rapid consumption of the coal by thorough draught, although not economical, might prevent the complaints. Mr. Iago.—We have done everything in our power and we cannot help it. We are bound by our Acts, under penalties, to supply the public with the light. That is our first duty. Mr. Horace Smith.—No; the first obligation is not to poison the atmosphere with foul smoke. Mr. Percy Gates said there were two previous convictions—one resulting in an abatement order, and the other in a fine of £10. Mr. Horace Smith.—The penalty goes on increasing. This time it must be a fine of £20 and a guinea costs.

Trade Announcements.—Messrs. Johnson & Phillips announce the removal of their Manchester establishment to more commodious and convenient premises, situate at Duchy Chambers, Clarence Street, Albert Square (North), Manchester, to which address all communications should now be directed. A largely increased stock of cables, arc lamps, meters and other electrical apparatus will be held at these premises.

It is stated that the several businesses of the Eclipse Brass and Copper Company, Limited, are to be removed from Halifax to York, where commodious premises are being erected for occupation during January.

Wheeler Condensers.—The Birmingham Electric Supply Company have decided to entrust the Wheeler Condenser and Engineering Company with the installation of one of their Barnard-Wheeler water cooling towers, suitable for engines of 2,000 H.P. With the above cooling tower is to be supplied one Wheeler Admiralty surface condenser having 3,200 square feet of cooling surface, mounted directly upon their combined horizontal air and circulating pumps. The gravity filter tank, hot-well pump, and pressure filter has also to be supplied, making a complete condensing outfit to deal with the above H.P. Messrs. Bewick, Moreing & Co. have also ordered one of the Wheeler combined condensing sets for the new mining engine required for the Great Fingall Consolidated Mines, Limited.

ELECTRIC LIGHTING NOTES.

Bermondsey.—The Vestry, at a meeting on Monday, adopted a report prepared for the Electric Lighting Committee by Messrs. Kincaid, Waller & Manville, the consulting engineers, and authorised them to draw up a specification for the buildings in connection with the electricity works. It was also resolved to advertise for tenders for the erection of a refuse destructor, without specifying any particular make, leaving for future consideration the type to be adopted. It appeared from the report of the consulting engineers that the design has been arranged on a somewhat liberal scale, so as to allow for extensions of the engine house to the extent of double the capacity. The present project comprises double the plant proposed by the original scheme, the new estimates of the engineers being as follows:—

Buildings	£17,000
Destructor	4,000
Generating plant	8,000
Boiler house plant	7,000
Mains, &c.	7,000
Public lighting	600
	£43,600
Contingencies, &c., 10 per cent.	4,360
	£47,960

Revenue.

10,500 8-c.p. lamps at 6d. per unit	£5,250
20 public arc lamps at 2d. per unit	194
40 public incandescent lamps, of 32-c.p., replacing arcs after midnight	89
	£5,527
Net saving on dust destructor	786
	£6,313
Maintenance per annum	3,300
Balance	£3,013

Financial Statement.

Interest and sinking fund	£1,980
Gross profit	3,013
Surplus	£1,033

In commenting on the foregoing estimates, the consulting engineers point out that the cost of building work has increased by from 25 per cent. to 50 per cent. according to the class, and machinery upwards of 50 per cent., during the last year, owing to the great rise in the price of raw materials. The revenue and maintenance have been estimated on the most conservative bases, and with this size of plant they believe that the revenue will exceed that put down in the estimate, whilst the maintenance should be less, leaving a bigger surplus, after interest and sinking fund is paid, than shown in the estimate. They suggest that they should be instructed to prepare a specification for the destructor cells and boilers, as, until the exact type of destructor cell is ascertained (which can only be after the Vestry has accepted a tender for this part of the work), the buildings cannot be absolutely designed; if the plant is to be running by next winter, no time should be lost in getting the work well in hand.

Birkenhead.—The Electrical Committee of the Birkenhead Town Council has resolved to apply to the Local Government Board for power to borrow £3,500 for electrical purposes.

Birmingham.—The Finance Committee of the Birmingham City Council has issued a report stating that the Public Works Loan Commissioners have decided to grant the loan of £500,000 for the purpose of enabling the Corporation to acquire the electric light undertaking. The Commissioners stipulate that the security for the loan should take the form of Corporation Stock, and the Committee recommend the creation and issue of such stock, the rate of interest to be 3 per cent., the stock to be issued on January 1st, 1900, redeemable by 80 instalments in 40 years.

Bristol.—It is proposed to increase the number of arc lamps used for street lighting from 306, the present number, to 792. The electrical engineer, Mr. H. F. Proctor, has reported to the Sanitary Committee of the Town Council that if the extensions are carried out the price per lamp can be reduced from £23 to £19 per annum; the total cost will then be £15,048 per annum for street lighting.

On Tuesday Mr. E. A. Sandford Fawcett held at Bristol an inquiry in consequence of an application made by the Bristol Corporation to the Local Government Board for power to borrow £15,300 for land for the purpose of new electric lighting works. Mr. Faraday Proctor, city electrical engineer, explained that the application was the outcome of the rapid extension of the use of electricity. In the first year of its existence the Electrical Committee supplied 9,000 lamps with current, in the next year 12,000 were added, and in the next 9,800, in the next 16,901, while during the portion of the present year there had been added 16,476. The additions for the part of the present year therefore exceeded the growth of any preceding year. The Local Government Board had sanctioned the purchase of new machinery, and it was necessary to get it to work as soon as possible. Mr. Wise, on behalf of the Electrical Committee, said they proposed to purchase 9 acres of land for these new works, and they asked that the loan might be repayable in 50 years. The inspector having asked if there was any question of the Electrical Committee taking up the electric trams, Mr. Wise replied that there was not; the Tramway Company had a separate power house. There is a considerable demand for electricity for motive power apart from the trams. The inspector proceeded to visit the site in question.

Calverley.—The District Council is considering the question of electric lighting, and making inquiries in connection therewith.

Cardiff.—Repeated failures of the electric lighting service in Cardiff have aroused much dissatisfaction in the Town Council and among the residents, though it must be said that few of them have been serious. One which took place on Saturday night was due to the blowing of a fuse in connection with a sub-station transformer, which cut off a number of consumers for half an hour. The Council had under consideration the question of calling in an expert of the highest standing to report on the whole undertaking, but decided to first obtain a report from the engineer, Mr. Applebee. Perhaps if the committee had not interfered with Mr. Applebee in the choice of his staff, these troubles would not have arisen.

The Local Government Board has sanctioned a loan of £3,200 for electrical purposes.

Clontarf.—The District Council proposes to obtain powers to light the township with electricity supplied from the tramway station.

Eastbourne.—The Corporation seeks to borrow £88,636 for the purchase of these works, and Colonel A. G. Hepper, D.S.O., R.E., (Local Government Board Inspector) held a public inquiry into the matter at Eastbourne yesterday.

Eccles.—The demand for electric current has become so great that the Corporation are being urged to undertake extensions. The works at present are on rather a small scale. The capacity of the engines is equal to 8,800 8 c.p. lamps, and nearly 7,000 lamps are already connected belonging to private consumers, besides which there are 500 public lamps in the borough. The electrical engineer to the Corporation, Mr. L. H. Combe, has resigned his position, having obtained an appointment elsewhere. The Town Council on Monday last resolved to advertise for a successor to him at a salary of £200 a year.

Edinburgh.—At a meeting of the Electric Lighting Committee of the Town Council last week, it was reported that during October over 6,000 8-c.p. additional lamps had been applied for.

Epsom.—The Local Government Board has sanctioned the borrowing by the Council of the sum of £16,100 for the purpose of lighting the district by electricity. The amount of the loan is to be repaid in 25 years by mortgage on the rates.

Farnworth (Lancashire).—Mr. Clirehugh has prepared plans for new electricity works for the Urban District Council of Farnworth. The clerk to the Council has been instructed to advertise for tenders for the works in accordance with these plans, and application will be made to the Local Government Board for power to borrow £22,000.

Isle of Man.—There is talk of the Isle of Man Tramways Company utilising water-power in connection with a scheme for the electric lighting of Ramsey.

Llanelly.—The District Council on Monday approved the scheme for electric lighting and traction for the town and district, and an agreement was sealed with the British Insulated Wire Company. The work is likely to cost £80,000. The lighting installation is to be completed within 12 months, and traction is to be provided in three years.

Long Eaton.—The Urban District Council has resolved to apply to the Board of Trade for a provisional order for the supply of electricity in the district.

Lynton and Lynmouth.—Mr. J. H. Fookes Bale, A.M.I.E.E, who has been manager and director to the Electric Light Company here for the past five years, has resigned his post and will leave shortly. Mr. P. T. Kimmins, who was assistant engineer for several months, will fill the vacancy as soon as Mr. Bale has left.

Lytham.—A special meeting of the District Council was held last week for the purpose of considering the estimate of the engineers instructed to advise and report as to the cost of an electric installation. It was unanimously decided to proceed with the scheme.

Maidstone.—The Urban District Council has accepted tenders to the extent of £14,292 9s. 8d. in connection with the electric lighting of the borough.

Middlesex.—Messrs. Ellis & Ward are now carrying out the electric lighting of the works of the Fibrous Manufacturing Company, Middlesex.

Mile End.—At a special meeting of the Mile End Vestry last week, it was decided to make application to the Board of Trade for a provisional order to light the hamlet by electricity.

Newhaven.—The District Council has resolved to grant the Electric Lighting Syndicate permission to obtain a provisional order.

Plumstead.—The Vestry has decided to appoint an electrical engineer to advise on designs and take sole charge of the electric lighting department at a salary to commence at £400 a year.

Queenstown.—The tender of the Cork Electric Tramway and Lighting Company for the electric lighting of the town has been approved by the District Council.

Shildon.—The District Council has resolved to apply to the Board of Trade for a provisional order for electricity supply.

Salford.—At Wednesday's Council meeting approval was given to the plans and estimates for the whole of the machinery, plant, and distributing mains in connection with the new electricity generating station, amounting to £335,783 (including the sum of £87,200 for dynamos and boilers already applied for), and application is to be made to the Local Government Board for borrowing powers. Mr. Haworth, the chairman of the Electricity Committee, said that in order to expedite matters the Local Government Board had promised to hold an inquiry into the matter a week hence, in the event of the resolution being adopted. The electric trams were expected to be running 17 months hence, and that being so it was important to proceed simultaneously with the erection of the buildings and the provision of the plant. A good plot of land in Pendleton, bounded on one side by the railway and on the other side by the canal, had been obtained from the Highways Committee of the Corporation. The present generating station was of 660 H.P., and the new one would be of 10,000 H.P. A sum of about £95,000 had been already spent, and the expenditure now contemplated was about £400,000. This included the cost of the provision of arc lamps for street lighting, but the Lighting Committee had not yet decided whether they would adopt this method of lighting. The provision that was being made for traction included cables such as would be suitable for the heavy traffic on race days, and in the event of the racecourse being shifted to Broughton the cables could be removed and put in suitable conduits that would be laid there. Application is also to be made for borrowing £50,000 for buildings for the new station.

Mr. Ducat, of the Local Government Board, will hold an inquiry in this borough on the 14th inst., with reference to an application by the Salford Corporation for permission to borrow £398,600 for electric lighting purposes.

Shoreditch.—The attention of the Vestry was directed by the Finance Committee, at a meeting held on Tuesday, to the great delay arising in the sanctioning of loans in consequence of the attitude of the officials of the London County Council. It appeared that those officials required minute details of expenditure under different headings and allocations from those provided in the detailed statement of the capital account of the undertaking prepared under the Board of Trade form. It was decided to make a representation to the Finance Committee of the London County Council on the subject, and to communicate the Vestry's views to the Islington authority, which was placed in a similarly awkward position. The Valuation Committee reported having discussed a letter from the London County Council requesting the Vestry to reconsider the question of the assessment of the electricity and dust destructor works, and make the necessary alterations in the assessment in the current list. The Committee recommended that the assessment of the combined undertaking, including mains and sub-stations, should be increased as follows:—Gross value from £1,800 to £3,600, and rateable value from £834 to £2,700. The recommendation was adopted without discussion. At the suggestion of the Lighting Committee the Vestry resolved to include in the specification now being prepared for new machinery, provision for a 165-KW. transformer for the Worship Street sub-station, and it was also decided to obtain a 100-KW. motor transformer from the Electric Construction Company for the same sub-station. The Vestry further resolved to obtain tenders for the construction of a new sub-station at the junction of Great Cambridge Street and Hackney Road.

Shrewsbury.—A failure occurred in the electricity supply on Saturday evening, causing great inconvenience to the townspeople. Mr. Johnson, the electrical engineer, states that the incident was due to an underground suction pipe, of which there was no duplicate, suddenly giving out, causing the supply of water to the boilers to be interrupted, so that there was no alternative but to shut down the machinery and switch off the light. Mr. Johnson succeeded in carrying out the necessary repairs to renew the supply of the light on Sunday.

Stourbridge.—The Urban District Council of Stourbridge intends to oppose the application of the Midland Electric Company for supplying electricity in the Council's district.

West Ham.—The Town Council has decided to fix the salary of the electrical engineer, Mr. Bock, to commence at £350, rising by increments of £25 to £450, and that of Mr. Steinitz, as consulting engineer for one year at £150.

West Kirby.—The District Council has accepted tenders amounting to £20,660 5s. in connection with the electricity works.

Whitechapel.—The Whitechapel District Board of Works has decided to obtain a loan of £30,000 from the London County Council on the instalment system for 42 years for the carrying out of the first portion of the electricity works.

York.—The Electric Lighting Committee of the Corporation, in the report submitted to the Council last Monday, states that with the view of inducing large consumers to take a supply of energy, the committee have adopted the following tariff for consumers who use more than 5,000 units per annum:—Over 5,000 and not more than 10,000 units, 7d. per unit for one hour's standard demand, and 2½d. per unit for all beyond the standard consumption of one hour per day. Over 10,000 and not more than 15,000 units, 7d. and 2d. Over 15,000 units, 7d. and 1½d. The committee has entered into a contract with Messrs. Venner & Co., London, for the supply of Chamberlain & Hookham meters at the price of £4 17s. 6d. each, for meters of 5 to 10 amperes capacity, and £5 each for meters above 10 and under 100 amperes capacity, during the next 12 months.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bradford.—A number of new electric cars have been put on the Great Horton route, and a more frequent service is now provided.

Bristol.—At the County Court last week J. O'Brien, a drayman, claimed £6 13s. for damages done by an electric car of the Bristol Tramways and Carriage Company. The car collided with the dray, knocked O'Brien off his dray and injured his back. Judgment for the plaintiff for the amount claimed.

Darlington.—To the Council, sitting as General Purposes Committee last week, the Tramways Committee submitted a letter from Mr. Burnley, the local solicitor to the Imperial Tramways Company, in which he said that the promoters of the light railway, before entering into an agreement with the Corporation for the supply of electrical power, desired to have a modification of the terms of the agreement already entered into as to the various routes. The company desired to postpone the carrying out of the railway from High Row to Bank Top Station, and the railway through Blackwellgate, the Haughton Road route, and the Conniscliffe Road and Salisbury Terrace line. The Committee resolved that they would not deviate in any way from the original agreement that a complete system should be laid down within two years of the granting by the Board of Trade of the necessary order.

Dudley.—Our local correspondent writes:—It is a pleasure to be able to state that greater satisfaction is now being found with the Dudley electric trams. They are running regularly at proper intervals, their frequency is equal to the public requirements, and those persons who were so ready with their hostile criticisms a month or two ago are significantly silent. The line from Dudley to Wolverhampton is in course of construction for electric traction, and it is anticipated that the new cars will be running thereon in six months. Progress is also being made with the Kingswinford and Netherton lines from Dudley, both of which will be of enormous advantage to the district.

The Tramways and Electric Lighting Committee recommend the Council that they be an executive committee for the purpose of carrying out the necessary work of constructing and equipping the electrical station, and all matters in connection with the question of the supply of energy in reference to the tramways in the borough. They have decided the position of the turnouts, and the part of the route upon which bracket poles and span-wire system respectively should be adopted in connection with the reconstruction of the Dudley and Wolverhampton tramway within the borough.

Electrical Motor Carriage Run.—We are informed that one day last week an electric game cart of the Electrical Undertakings, Limited, did the journey from Piccadilly Circus, London, to Hôtel Metropole, Brighton, with only one charge of batteries. The rate of travelling averaged 11 miles an hour.

Greenock.—The Police Board recently invited offers for the leasing of the tramways system. It is stated that the conditions set forth were very stringent, and only one offer has been received; that is from the Greenock and Port Glasgow Tramways Company.

Hemel Hempstead.—The Highways Committee of the Town Council has been considering the schemes of the British Electric Traction Company and of the Herts County Council to promote a tramway service. Under certain conditions, the Committee recommends the Town Council to support the company's scheme.

Kidderminster.—An electric tramcar coming down Comberton Hill collided with a dray. The car, car driver, and dray driver were all the worse for the occurrence.

Leeds.—A local paper says that 50 additional electric cars are to be ordered by the Corporation from Messrs. Dick, Kerr & Co. for £28,896. They are to be delivered at the rate of 10 a month.

Light Railways in Belgium.—If progress is any sign of satisfaction, the Belgians must surely have solved the question of light railways with some considerable amount of satisfaction. Since 1884 the Government have subscribed nearly 4½ million sterling towards the cost of the Vicinal railways. The lines are constructed by the Societe Nationale des Chemins de Fer Vicinaux, founded in 1884. Over 1,021 miles are now in operation in 76 lines; 18 other lines when complete, will bring up the mileage to 1,371 miles if we include three new concessions. Eighty-five new projects are under consideration, which will, probably, be subjected to weeding out, give another 43 miles. These lines are not all. There are other lines owned by various companies, aggregating 43 miles, bringing the total to 1,414 miles, as compared with the main line railways, which aggregate 2,858 miles. The ratio is thus about 50 per cent., and calculating thus, there ought to be about 10,000 miles of light line in England. The Vicinal lines are laid to the metre gauge, except where there appears a prospect of them being worked in connection with the main lines, or they are actually so worked when the broader gauge of 4 feet 8½ inches is adopted. If likely to be connected with the lines in Holland, the gauge is (3 feet 5·66 inches) 1·067 metre. The mean cost of rolling stock has been nearly £637 per mile. Locomotives weigh in most cases 18½ tons. Their total number is 321, or about one to each three miles of principal way. One line is worked by horses and one by electricity, while others are now being prepared for electric working. The working expenses are 67·2 per cent. of the gross

receipts, and last year the train mileage was nearly five millions. Out of 69 lines that have been worked for more than one financial year, not one has shown a loss; 31 pay over the guaranteed dividend, 9 pay more than 3 per cent., 10 pay over 2½ per cent., and 8 pay above 2 per cent. The results are at least encouraging for so small a country as Belgium, and would be paralleled, there can be very little doubt, in England, were it not that the intention of Parliament is frustrated at every turn and corner by the action of authorities and of railway companies. It was a great mistake to ever leave agreements between projected lines and established railways to be mutually arranged. There ought in all cases to be provision for compulsory and prompt settlement of disputed points. As matters stand, the will of Parliament is practically blocked by any peevish or irrational man with whom agreement is necessary. Parliament, while appearing to favour light railway extension with one hand, stays progress with the other by its overweening regard for municipalisation.

Liverpool.—It is proposed to include in next year's estimates a sum for reconstructing, for electrical working, the whole of the lines which are now worked by horse haulage—a distance of 40 miles—and to arrange for the construction of new lines. About £350,000 will be needed to complete the work. A Manchester paper remarks that the Corporation look upon the expenditure, large as it is, with a light heart, knowing, from the experience already gained of the workings of the electric cars, that a capital return for their investment is assured.

Llanelly.—The Borough Council has decided to seek powers to light certain portions of the town and to run electric cars from Llanelly to the outlying villages of Pwll, Felinfoel, and Llwynhendy.

Newport.—At the last Council meeting it was stated that the South Wales electrical power scheme was being watched by the Electricity Committee, along with other Bills affecting the town and district.

There is grumbling regarding delays on the tramways, and it is stated that these cannot be remedied until the electrical traction scheme, now submitted for Parliamentary sanction, gets to work, in about two years' time.

Rochdale.—The tramways to be constructed under the Rochdale Corporation Bill to be introduced next session will embrace a total length of about 18 miles, and will cost (exclusive of the amount required for the purchase of the present tramway company's property) about £250,000. The scheme proposes to alter the gauge of the tramways from 3 feet 6 inches to the standard gauge of 4 feet 8½ inches, with a view to joining up with the systems of the neighbouring authorities of Oldham and Bury. The Bill also seeks power to construct several new streets and to widen others, with a view to better communication, both for ordinary and tramway traffic, with the outlying parts of the borough. This will involve a further expenditure of about £50,000.

St. Helens.—At a special meeting of the Electric Supply and Tramways Committee the electrical engineer submitted a statement showing the amount already expended on the electrical equipment of the tramways on the Prescot and Denton's Green section to be £25,866. This was £866 in excess of the amount already authorised to be borrowed. The engineer also submitted his estimate of the cost of the electrical equipment of the Haydock and Peasley Cross sections and of the extensions now being carried out. It was resolved to apply to the Board of Trade for their sanction to the borrowing of the sum of £25,000, the total amount required for the purposes mentioned. It was also resolved to apply to the Local Government Board for permission to borrow £20,000, to cover the cost for plant laid down and proposed to be increased at the Cropper's Hill power station.

Last week the Council formally approved of an application being made to the Board of Trade for a provisional order sanctioning the construction of the new tramways.

San Paulo, Brazil.—A Brazilian water-power plant is about to be laid down to obtain 16,000 H.P. from the Tieté river, and transmit it electrically to the city of San Paulo, 24 miles distant. A masonry dam, 1,000 feet long, and 35 feet high, will be built, and the water will be conducted by a steel conduit 12 feet in diameter, and ½ mile long, to turbines. These have been contracted for with the Stillwell-Bierce and Smith-Vaile Company, together with other machinery for the power plant, at a cost of £100,000. The electric energy to be developed is to be used by the San Paulo Tramway, Light, and Power Company, which controls 104 miles of street railway track in that city. The contract for the electrical equipment is yet to be placed. Capital to the extent of £1,000,000 is to be furnished for the undertaking by American and Canadian capitalists, and the time required for the completion of the entire plant is two years. Mr. F. S. Pearson is the consulting engineer to the company. Mr. R. C. Brown is the general manager; he is in charge at San Paulo, and Mr. H. L. Cooper is the chief engineer of the hydraulic installation.

South Coast.—A scheme for an electric tramway connecting the coast towns between Margate and Hastings, at a cost of £330,000, was before the Dover Town Council on Tuesday, the promoters wishing for running powers over the municipal tramways.

South Lancashire.—The large scheme promoted by the South Lancashire Tramways Company is being rapidly pushed forward. The capital required is understood to be about £1,000,000. The scheme provides for the construction of electric tramways from the terminus of the St. Helens system at Parr, to proceed through Newton, Earlstown, Leigh, and Atherton to Bolton; from Atherton through Tyldesley and Worsley to Patricroft, connecting with the Ship Canal; and from Atherton to Little Hulton, through Walkden, and connecting with the Manchester Tramway system at Swindon. The total length of lines, with branches and junctions, will be 82 miles, and they will tap large and important industrial centres. Amongst the companies interested are the St. Helens Tramways Company, the British Insulated Wire Company, and a number of leading electricians in various parts of the country. The engineers to the scheme are Sir W. H. Preece and Major Cardew, of London, and Messrs. Kincaid, Waller & Manville. The various authorities through whose areas the lines will pass are favourably disposed toward the project, which is one of the most important ever put forward outside Manchester and Liverpool.

Southport.—The negotiations between the Southport Corporation and Birkdale and Southport Tramway Company have at length come to a satisfactory issue. The Corporation desired to purchase the portion of the company's lines in the borough of Southport, and to work them in conjunction with the new lines which they are laying down for the purpose of introducing electric tramways in Southport. The company has been in existence for some 19 years, and for some time past has declared satisfactory dividends upon its stock. On more than one occasion the proposals have been within an ace of breaking down, but the final offer of the Corporation has been accepted this week by the directors. The price has not transpired, and the bargain will require confirmation by the Council and ratification by the shareholders of the company before it is complete. The Corporation are also seeking Parliamentary powers for the purchase of the portion of the company's line in Birkdale, failing its acquisition by the local authority of that township, with the object of carrying out a comprehensive system of electric tramways. The permission to borrow £66,000 for the work in Southport has just been received from the Local Government Board, and this portion, it is hoped, will be completed by next summer.

Walsall.—The Corporation of the Borough have concluded an agreement with the South Staffordshire Tramways Company, the British Electric Traction Company, Limited, and the South Staffordshire Tramways (Lessee) Company, Limited, under which the Corporation are to purchase the whole of the tramway undertaking in the borough (except the James Bridge generating station) as from December 31st, 1900, at the price of £18,500, and the Corporation are to grant a lease to the Lessee Company of so much of the lines as extend from the Brown Lion Inn, Wednesbury Road, Pleck, to the Wednesbury boundary on the Bescot Road, and also to the Darlaston boundary at James Bridge, for a term of 21 years from January 1st, 1901, and of the remaining portion of the tramways in the borough for a term of three years from the same date, at such a rent as will indemnify the Corporation from all loss in regard to the undertaking, and relieve the rates of any additional burden in respect of the purchase.

Warrington.—The Town Council held a special meeting last week to consider a proposal to apply to the Board of Trade for a provisional order sanctioning the construction of tramways in the borough. It is proposed to construct four main lines, extending from near the centre of the town to the principal suburbs, but avoiding, as far as possible, the streets which are narrow and congested. Electric traction is contemplated, but power will be sought to use either mechanical or horse-power. The town clerk, in a report which he presented, said that the Tramways Committee called Major Cardew in to advise them as to the best routes and system to be adopted. The town clerk emphasised the necessity of keeping private companies at a distance, though he said this was not the main object in seeking a provisional order, for, so long ago as 1882, they approved the principle of tramway construction for the borough. Certain streets which had been originally scheduled had been struck out. They had been advised all through by Major Cardew that in the first place they should not overburden the application, which covered all the main arteries of the borough, and no scheme would be accepted or permitted which did not in the first instance include these main arteries. The estimated cost of the scheme is £170,000. The adoption of the report was unanimously agreed to.

Wellingborough.—The Finedon Urban Council last week listened to Mr. Stephen Sellon's explanation of the details of the British Electric Traction Company's scheme for electric tramways for Wellingborough and district.

West Bromwich.—The Council is considering the promotion of a Bill to confer powers respecting tramways, electric lighting, and other undertakings.

West Cumberland.—It is reported that a proposal has been made to the Corporation of Whitehaven by a substantial company seeking to acquire powers to run a tramway through the borough on the overhead wire system. A plan submitted shows a line from Cleator Moor through Whitehaven to Distington. The route from Maryport to Allonby has been surveyed by Mr. Ward Thomas, of the firm of Messrs. Bennett & Ward Thomas, electrical engineers, Manchester, on behalf of the English Industrials Company, Limited, who contemplate the construction of an electric tramway under the Light Railways Act between Maryport and Allonby. The distance from Maryport to Allonby is about five miles, and with the exception of a brow near Netherhall and the one just outside Allonby the road is almost level. The clerk to the Maryport District Council has been informed that if the Council succeeds in securing a provisional order for supplying electricity, application will be made to them for electric power to work the proposed tramway.

TELEGRAPH AND TELEPHONE NOTES.

Grimsby Telephones.—The Corporation Highways Committee have had under their consideration the advisability of establishing a municipal telephone in the borough, and the matter has been referred to the Sub-Lighting Committee.

Manchester Telephones.—A number of gentlemen interested in the New Mutual Telephone Company met on Monday in Manchester, under the presidency of Mr. Wm. Thomson, to petition the City Council to reaffirm its resolution of April 14th, 1897, in favour of a license being granted to the company by the Postmaster-General. The Council followed up its former resolution by appointing a deputation to wait upon the Postmaster-General so late as May last. Subsequently, however, a feeling was developed in favour of a municipal telephone service. It is submitted on behalf of the company that, under the resolution which the company ask, it would be impossible for them to establish competition in Manchester, after the license is obtained, without the formal consent of the Council. Further, as the company has undertaken to transfer its interest in a competitive system in Manchester (if it be allowed to create one) to the Corporation, it is obvious that if the City Council should elect to establish a municipal service forthwith it can do so. If the Corporation decide to commence a telephonic exchange in Manchester, the company would still be essential to extend efficient telephonic communication in the surrounding manufacturing towns having intimate business relations with Manchester. It is imperative, however, to comply with the requirement of the Postmaster-General by re-confirming the previous resolution, so that no injustice may be done to the merchants and inhabitants of Manchester, and to those who have expended so much time and money in the effort to establish competition in the telephone service of the district. The chairman explained the position of the Mutual Company. If they failed to obtain a license by December 31st next, they would cease to exist as a company. Further delay by the Corporation meant death to the company. But for the creation of the Mutual Company, the existing service in Manchester would not have been what it was, opposition having stimulated the National Telephone Company.—On Tuesday afternoon the Lord Mayor was waited upon by a deputation representing the New Company, who presented the petition, and urged reasons why the Corporation should accede to it without delay. A competitive system was declared to be an absolute necessity. With reference to the National Company's proposal to charge, in some cases, 1d. per message, in addition to an annual subscription of £3 10s., a member of the deputation insisted that this was anything but a concession. If he were to adopt that system of payment, it would mean, in his case, an annual charge of £50 in place of the present subscription of £10.

It was announced that at Wednesday's meeting of the City Council Mr. Plummer was to bring forward a motion to the effect that the Special Committee *re* Telephones be instructed to consider the question of a municipal license, and prepare a report and recommendation for the Council. He was also to move that the application of the Mutual Telephone Company, Limited, to the Postmaster-General for a license to provide a system of public telephone communication in the Manchester exchange area for a term which shall not extend beyond that of the existing license of the National Telephone Company be approved by the Council, "subject to the terms and conditions on which the Mutual Telephone Company shall hold and exercise such license being hereafter arranged to the satisfaction of the Corporation, and reserving to the Corporation a status to communicate with and be heard before the Postmaster-General or other Government authority in reference to the subject."

Paris Telephones.—It is stated that the Paris telephone tariff is to be reduced on January 1st, 1902, from 400 francs to 300 francs a year, and the cost of a three-minutes' conversation is to be at once reduced from 25 cents to 15 cents.

Pembroke Telephones.—The District Council will not allow the National Telephone Company to erect poles for telephone service unless a charge of 10s. per pole per annum is agreed to. The present agreement with the company is to be rescinded from January 1st next.

Proposed American Cable to Manila.—Reuter's Washington agent says that the report of Mr. Elihu Root, Secretary for War, strongly recommends the laying of a cable between San Francisco and Manila, to touch at Hawaii, Wake Island, and Guam, as of great military and political importance. He estimates that the cost will not exceed $8,500,000.

In his presidential address President McKinley refers to the necessity for a cable to Manila, and it is suggested that should not Congress authorise the construction of the cable by the direct action of the Government, the Postmaster-General should be authorised to invite bids for the laying of such a cable.

Subways of London.—The Corporation of the City of London are seeking powers in the coming Parliamentary session to construct subways under the streets for the accommodation of electric lighting, telegraphic, telephonic, and other electric cables and wires, and they seek also compulsory authority to enforce the placing of these things in the subways.

Proposed French Submarine Cables.—The Paris correspondent of the *Times* made the following interesting remarks on the subject of a French submarine cable service in a despatch dated November 30th:—

The Government has resolved on proposing a scheme for the construction of a system of French cables, and the *Figaro* urges that France cannot safely remain dependent on English companies, but must have a complete system of communication with all her possessions. As soon as the Transvaal war broke out the papers began to publish articles protesting against the monopoly of telegraphic cables by the foreigner, and the Government was attacked for not taking the initiative of a new system so that France might be independent of the foreigner. As always, it was the note of patriotism for the benefit of the public and the Fatherland, but also for the benefit of those who were putting forward claims for work in connection with the laying down of the future colossal network. A nation, no doubt, should have such a network of its own, and the present agitation is not incomprehensible. But in France, as in England, private initiative should undertake to respond to this want. As it is, we are to see what is always behind here. The State will be asked to guarantee a certain rate of interest, and so even the taxpayer who has nothing whatever to do with the cables will have to pay. The system is deplorable, for it paralyses individual action and keeps an industry going at the expense of everyone's purse. It is Socialistic indolence. The work goes on without conviction because no one feels any special risk, and the money spent by the State inevitably goes into the pockets of individuals. But when once the cry of "patriotism" is raised, a cry which serves for all purposes, no one any longer dares to make an appeal to reason and to sound principles of political economy.

The same correspondent, telegraphing the following day, said:—

The Colonial Committee of the Chamber has submitted a resolution calling on the Government to provide telegraphic communication with the Colonies. A preface to this resolution complains that the English censorship has been rigidly applied since the outbreak of the war in South Africa to countries outside the zone of hostilities, such as Madagascar, cipher telegrams to which have been stopped, even though these were Government despatches to their agents. In the event of war, accordingly, France might thus be prevented from telegraphing the outbreak of hostilities beyond Marseilles for the East, and Algeria for Africa. Colonial Governors might thus be without instructions and without the means of defence. It would be culpable imprudence not to avert this danger. Colonial commerce, moreover, as England's example proves, runs parallel with the extension of submarine cables. The Committee accordingly recommend cables in the Atlantic, the Indian Ocean, the Far East, and the West Coast of Africa, at an estimated outlay in five years of 100,000,000 francs.

Reuter's Paris agent says that on 2nd inst. M. Millerand, Minister of Commerce, presided at a meeting of the Cables Committee, which he had summoned for the express purpose of submitting to it the outline of a Bill elaborated by the Government with the object of uniting the colonies to the mother-country by French cables. After a conference lasting two hours, the Committee accepted the proposals of the Minister and appointed a sub-committee to draw up as soon as possible the details of a Bill to be laid before the Chamber.

The Reduction of Rates to India.—The following letter, written by Mr. Henniker-Heaton, M.P., appears in the Indian press:—

The merchants of India, the Press of India (without regard to politics) and in fact, the whole of the people of India have given expression to thanks and goodwill to those associated with me, engaged in the task of reducing the high postal rates of the past and high telegraph rates of the present time between the mother country and her Dependencies. A critical moment has arrived, and I ask for the strongest possible support in my appeal to the Viceroy and his Council.

We are on the eve of success. Telegraphic communication between Great Britain and India can be reduced to 1s. a word at this moment if the Viceroy and his Council wills it. I will explain what I mean. The telegraph rate from London to Fao (at the head of the Persian Gulf) is now 6¼d. per word. From Fao to Kurrachee the Indian Government own the cable and telegraph line, and it will pay them well to convey the telegrams for 6d. per word. It is about 3,400 miles from London to Fao, and only about 1,400 miles from Fao to Kurrachee.

"Who stops the way?" is asked. I have information of a very grave character in reply to this question, which I decline to believe at this stage of the proceedings.

It is alleged that the telegraph line is working badly between Fao and London, but well between Bushire and London. Now I pledge my political reputation to remedy this with the aid of two eminent telegraph officials in India, and I have a note from a high official in Turkey guaranteeing the help of the Sultan.

It is also alleged that the Telegraph Convention stops the way. This is nonsense. I have been a member and representative on these Conventions. The Convention is ruled by the Eastern Telegraph Company and its satellites.

We can break away from the Convention by giving six months' notice, so it is unnecessary to consider this point.

The Indian and Home Governments have had pressure placed upon them to grant a subsidy or give a guarantee to the Eastern Telegraph Company, on the ground that in war time it is necessary to have an all-British cable.

This is a very clever argument. But the answer is, that the Eastern Company's cables are landed in Portugal and go up the Mediterranean and the Red Sea; further that, in war time, it is impossible to patrol 2,500 miles of cable, and that the first thing the enemy will do is to despatch a vessel specially fitted up to cut cables. "Fast cruisers," said the ablest director of the Eastern Telegraph Company, when this question was raised some years ago, "is the only guarantee." Now the Eastern Telegraph Company, which has a joint-purse arrangement with the Indo-European Telegraph Company, is silent on this point, or professes to have an all-sea line which they dare not defend.

I and those associated have no interest to serve but one, and that is, to obtain cheap telegraph communication with every part of the British Empire. Only one telegram in a hundred is of a family matter, and social telegrams are almost impossible.

If the merchants and people of India do not successfully appeal to the Council of the Government of India against a subsidy to the Eastern Telegraph Company, we shall be handicapped, and our work will be in vain.

Sir Michael Hicks-Beach has promised us an inquiry, but meanwhile we are in the greatest danger of receiving a recommendation from the Council of the Government of India to give a guarantee to the cable companies against loss on reduction of rates.

I am writing very hurriedly to catch the post. I hope every paper in India will publish this letter.

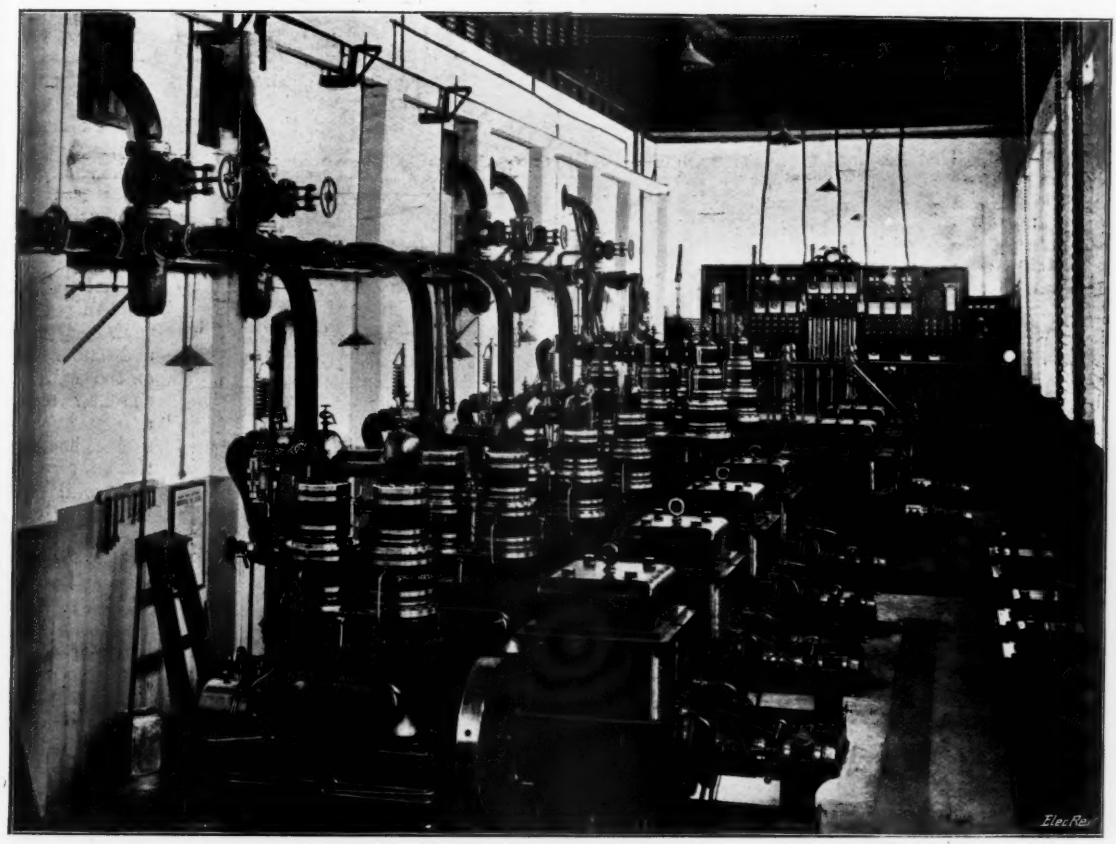
Telegraphic Communication between Buda-Pesth and London.—The *Times* correspondent at Vienna says that on the afternoon of the 4th inst. direct telegraphic communication between Buda-Pesth and London was opened by an exchange of complimentary messages between M. Hegedus, the Hungarian Minister of Commerce, and the English Postmaster-General, the Duke of Norfolk. The line is 2,200 kilometres long. It passes through Austria, Switzerland, France, and the Channel. Copper wire has been principally used.

(*Continued on page* 931.)

THE PERTH (W.A.) ELECTRICITY WORKS.

The first attempts at electric lighting in the city of Perth, Western Australia, were not attended with good results; several companies were formed, but did little or nothing. A concession which was about to be given to another company, was opposed by the Gas company; this led to a public ballot, in which the electric light side won, but it was not able to carry out its ideas for lack of funds. After some time, when electric lighting was again talked of, the Gas company thought it would be advisable to take up the matter on their own account. Accordingly, after getting an Act empowering them to supply electricity, they put down a plant consisting of a boiler of the locomotive type and a horizontal engine of 100 I.H.P., driving two dynamos each giving 240 amperes at 110 volts. The three-wire system of distribution was adopted; cables were fixed on poles in the busier portions of the city, a few consumers connected, and current supplied from sunset till midnight. The charge was fixed at 1s. per Board of Trade unit, but owing to the limited scale on which the operations were carried on, the company worked at a loss for three years.

About three years ago the city began to increase very rapidly, and the company, seeing that their machinery would soon be too small, ordered a complete up-to-date outfit of generating plant from Messrs. J. H. Holmes and Co., Newcastle-on-Tyne. The firm had also to erect the machinery, and to guarantee its working; they therefore sent out with it Mr. Herbert Broadbent, who had had much previous experience abroad with their machinery. It was originally intended to run the new machinery in conjunction with the old, but eventually a new site was chosen, and a handsome generating station erected thereon. Everything was complete and in running order in April, 1897; the load began to increase rapidly, and during the Jubilee celebrations the plant was taxed to its utmost capacity. The plant then consisted of three Babcock & Wilcox boilers, with all the necessary steam pipes, pumps in duplicate, feed water heater, &c., and four 80-H.P. Willans engines, coupled direct to four "Castle" dynamos, two of which were rated at 110 volts, 400 amperes each, and two at 220 volts, 200 amperes each. A handsome three panel slate switchboard, with all the necessary instruments, including battery regulating switches, &c., and two sets of accumulators each of 63 cells, completed the equipment.



Perth (W.A.).—Engine Room.

It was soon seen that the plant would be too small, so more machinery was ordered, and at the same time it was decided to double the voltage, to save the necessity of having shortly to increase the size of the feeders. This order included two Babcock & Wilcox boilers, pumps, heater, &c., and two three-crank compound Willans engines, coupled to two "Castle" dynamos of 440 volts, 250 amperes each, as well as new armatures and bobbins to alter the 110-volt machines to 440 volts, and two motor-generators for charging and discharging the battery, which was decided on in preference to doubling the number of cells. Long before these arrived the other machines were over-taxed, and the company had to refuse to connect intending consumers; at last, however, the machinery was fixed, and on May 16th last everything was in readiness for changing-over the system.

F

Before this date all the large consumers' premises had been altered to 220 volts, and in one or two cases whole streets had been changed, which helped to expedite the work considerably, as it was only necessary to remove the outer wire from its socket at the corner of the street, and put it in the middle wire socket, of course, to be replaced at a convenient opportunity and the proper balancing effected. Altogether there were about 80 places where the wires required changing from the outer to the middle, and about 350 premises to be entered to change the lamps.

About seven in the morning on the above date the whole staff (who had previously had their instructions) turned up; everybody had been pressed into the service for lamp changing, switchboard attendants, carpenters, &c., all entered into the spirit of the thing, each anxious to be first to telephone to the works when he had got to the end of his list; in fact, great rivalry was shown, as each man was handicapped according to his knowledge of the work; each had a list showing the probable number of lamps required for each of the premises to be visited, and was provided with a carrier's cart, boxes of lamps, and a step-ladder.

The procession set off about 7.30, but the men were not able to do much till the business premises were opened; several of the men, however, had arranged with clients on their round to let them have access earlier, others had planted ladders at different places on their route, to save time, and others availed themselves of the services of willing volunteers. The first to report at about 11.30 was then told off to assist another not so fortunate. Between 12 and 1 the telephone was busy with reports, but the last did not reach the works till about 2.30, very far behind the others, as the difficulties on his route had not been so accurately gauged. During this time work was not at a standstill in the station; a 440-volt machine choked down to 220 was kept on all day with the battery as a balancer, the alterations to the connections on the switchboard were commenced, the 220-volt connections taking the place of the 110, and new voltmeters, ammeters, and watt-hour meters were fixed. Everything was in readiness at 2.45, before which hour the men on the cables had reported everything changed except the post office, as had been previously arranged; directly everything was ready in the station word was sent to change this wire quickly and telephone immediately. In the meantime pressure was got up on the 220-volt machines, and directly word was received off went the battery, and on went the dynamos, and the change over was an accomplished fact at 3 p.m.; everything went smoothly, and hardly a complaint was received.

Much remained to be done afterwards, such as converting the 110-volt machines to 440 volts, changing arc lamps, and making good the connections to the cables in the streets. The meters were the most serious part of the whole business; Ferranti meters are in use, so the meter readings are doubled, and it is a very difficult matter to explain to a good many of the consumers that they are not paying twice as much for the new as for the old pressure.

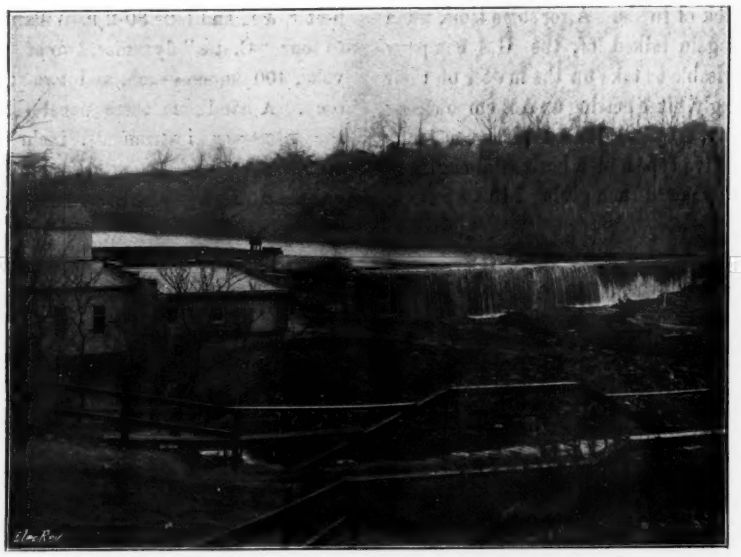


Fig. 1.—Dam of Albion Power Company at Waterport.

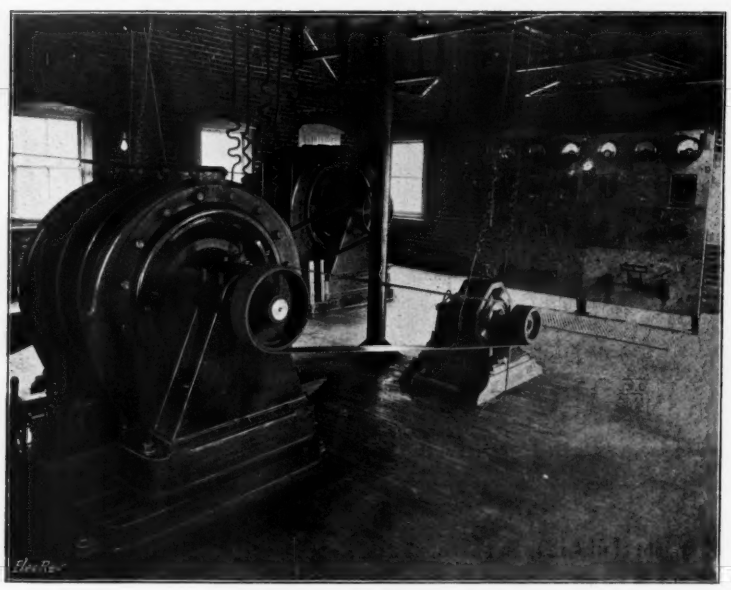


Fig. 2.—Generating Station at Waterport.
Water-Power Transmission Plant.

Our illustration, for which we have to thank Mr. Broadbent, shows a view of the engine room, which is 100 feet long by 22 feet wide. The motor-generator panel is on the extreme right of the switchboard, and the battery switches and shunt resistance on the centre panel; the new machines are nearest the switchboard, and the converted ones next, while on the right the boosters are visible.

The whole of the scheme for the additions and alterations was planned and carried out by Mr. H. Broadbent, who, on the completion of his contract with Messrs. J. H. Holmes and Co., took sole control of the department, which is maintained in a thoroughly efficient condition; there has not been a single failure of the light since its installation, and so rapidly is the consumption increasing that further extensions will have to be considered very shortly.

We may add that a very substantial balance on the right side resulted from the first year's working of the new station.

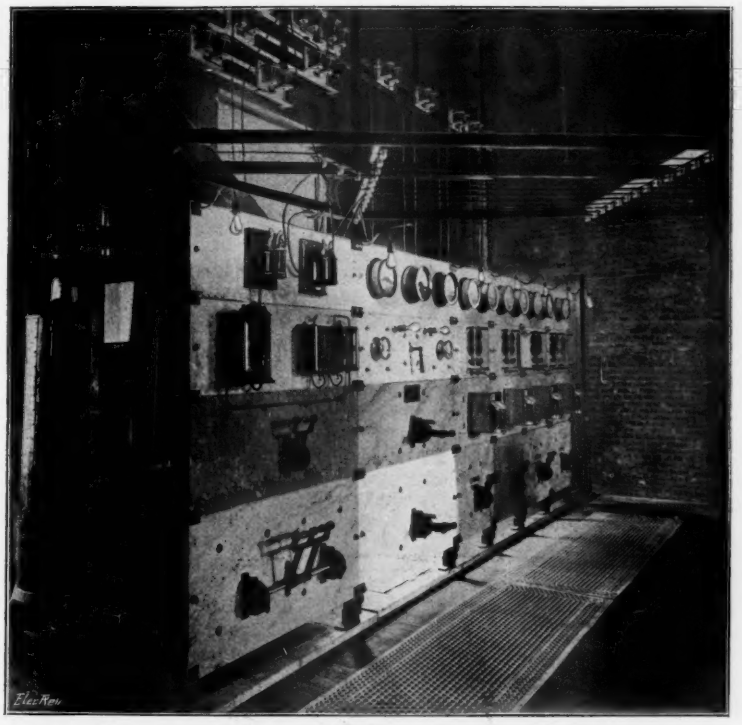
A WATER-POWER TRANSMISSION PLANT.

By ORRIN E. DUNLAP.

There is no doubt but that numerous places in the United States and Europe can profit largely by what has been accom-

plished by the Albion Power Company in their generating plant at Waterport, and their sub-station in the village of Albion, both places being in the county of Orleans, east of Niagara Falls. This company has a capital of $50,000, and it secured water and power rights on Oak Orchard and Otter Creeks at Waterport. At that point the Oak Orchard Creek runs through a deep gorge, the banks being quite high. Here the Albion Power Company has constructed a dam 200 feet long and an earth embankment 100 feet long. This dam has a height of 12 feet, and it sets the water of the Oak Orchard Creek back for fully three-quarters of a mile, the company owning all the land likely to be flooded by the water. Thus a big reservoir is formed from which a full supply of water may be drawn at times of heavy load, the reservoir refilling at times of light load. The head of water available is 18 feet, the difference between this and the height of the dam being obtained by means of a tail race extending for 1,000 feet down the Oak Orchard Creek.

To the east of the dam, just behind the earth embankment, the company has built its generating station and power house. In the construction of the flume novel methods were adopted. It is set right into the earth embankment, and it is built of steel framework filled in with concrete, so that practically it is a concrete wall 2 feet thick. The steel frame is designed to sustain the pressure, while the concrete is used for filling in the spaces, making it tight at every point. The construction has been found to be most successful, and is likely to last for ever.



Water-Power Transmission Plant: Fig. 3.—View of Switchboard.

The company has installed two McCormack wheels made by J. & W. Jolly, of Holyoke, Mass. One of these wheels has a capacity of about 250 H.P., while the other is of about 175 H.P. capacity. These wheels are set right into the open flume on a horizontal shaft, discharging through a quarter turn and a draught tube outside the flume into the tail race. In the generating station the company has placed two alternators of Stanley make. One of these has a capacity of 150 KW. when operated at a speed of 600 revolutions per minute, and the other has a capacity of 100 KW. when operated at a speed of 900 revolutions per minute. Both machines are of the inductor type, three-phase, are wound for a maximum E.M.F. of 6,600 volts at full load, and are intended to generate current at 7,200 alternations. Each generator is designed to operate in parallel. The station is also equipped with two 6-KW. multipolar exciters, each capable of exciting the fields of the two generators when operating on a non-inductive load. These exciters are arranged for belt driving from the shaft of the generator. In one of the accompanying illustrations the generating room is shown, well portraying the location of the generators, one of the exciters, and the switchboard, which is of blue marble, and equipped with all the necessary instruments. Both of the generators feed directly into the transmission line at a voltage of 6,600. The larger generator is connected to the larger wheel, and the smaller generator is connected to the smaller wheel.

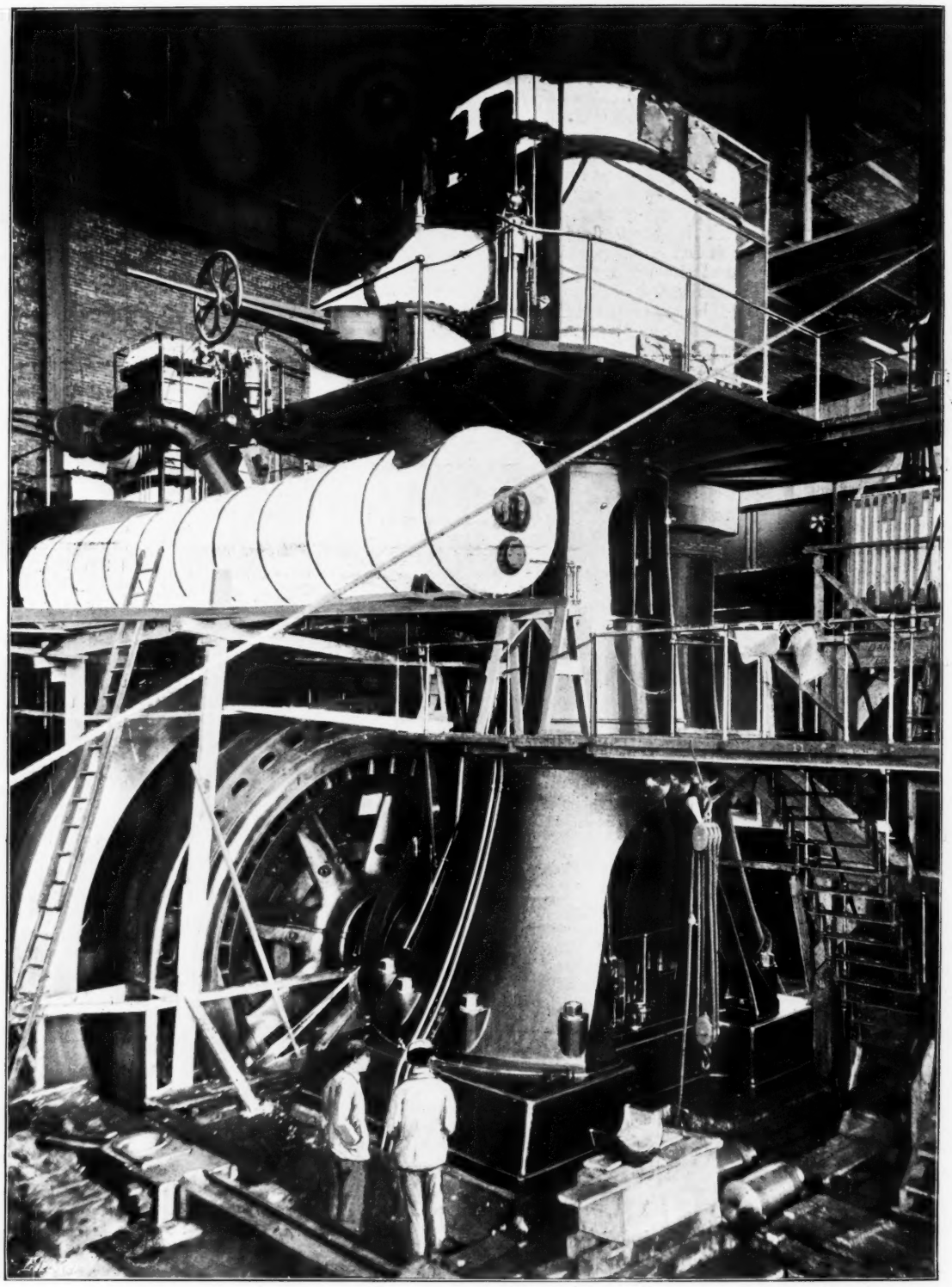
The transmission line also has its novel features. Waterport is situated 6½ miles distant from Albion, and this is the length of pole line. The poles are 30 feet high, and are set 100 feet apart. The cross arm supports three pure aluminium stranded cables, each cable being composed of seven wires. Triple petticoated glass insulators, on a porcelain base pin, having an iron bolt through the cross arm, and made by F. M. Locke, of Victor, N.Y., are used. When the line was first built, pure aluminium wire, about ¼ inch in diameter, was used, but as this was found to have been too tightly drawn, the stranded aluminium cable was strung to replace it, the first construction having resulted in numerous annoying breaks.

The current passes over this aluminium transmission line to the sub-station in Albion. This was the generating station of the old electric light company of the village, and was purchased by the Albion Power Company. In this sub-station the company has installed three Stanley static transformers, having a total capacity of 200 KW. These machines are of the indoor type, self-ventilating, for service without oil, and designed for continuous operation, transforming from 6,000 volts to 1,100 volts three-phase. The company has also placed in this station one 75-H.P. inductor type alternator for service as a synchronous motor, the same to operate on 1,100 volts three-phase, this motor in every way being a counterpart of the machines used in the generating station. A 1-KW. exciter to excite the fields of the motor, and one 5-H.P. three-phase motor for service in bringing the synchronous motor up to speed, have also been placed in the sub-station. The 75-H.P. motor drives an 80-light direct current Brush arc machine for public lighting. This sub-station is equipped with a complete steam plant, which gives the company a full reserve up to the capacity of the generating station.

The business part of the village of Albion has been divided into three districts by the company, and in each of these districts, in the street, there have been placed three 300-light transformers connected in parallel, stepping down to 110 volts. Each district is connected to one leg of the three-phase system. Running around the outskirts of the village there is also a three-phase line from which all outside lighting and all power are taken.

The total power available through the present development at Waterport is 400 H.P., and the development, transmission, and use of this force, have added much to the light and power conditions in Albion, which is the county seat of Orleans county. Electric power is supplied to a cold storage warehouse plant in Albion, and the Waterport Manufacturing Company has been organised to use power at Waterport.

The chief engineer and general manager of the Albion Power Company is Wallace C. Johnson, M.Am.Soc.C.E., of Niagara Falls. Mr. Johnson is well known both in Europe and America as the chief engineer of the Niagara Falls Hydraulic Power and Manufacturing Company, of Niagara Falls. Mr. Johnson had charge of all the plans of the development.



3,500-kw. Electric Railway Generator.

The electric contracts were placed by the Albion Power Company with the Niagara Electric Equipment Company, of Niagara Falls.

LARGE ELECTRIC GENERATORS.

At the present moment few questions are of so much interest to central station engineers as the increasing use of large generating units. From orders recently placed, it has been clear that 1,500 kw. direct coupled sets, and even larger sizes, will be pretty general in the extensions which are now being carried out.

The new works of the Midland Corporation for Electrical Power Distribution will be equipped with half-a-dozen sets of a total capacity of 10,000 e.h.p.; at Glasgow tramway power station there will be several 2,500 kw. three-phase generators; and at the Metropolitan Electric Supply Company's new works at Willesden, which have now arrived at a stage when they are nearly ready to be brought into service for practical supply business, there will be three Westinghouse sets of

2,500 to 3,500 H.P. each.* But large as these and the Manchester, City of London, and various new plants may be to English practice, they are small when compared with units which are now being manufactured or put into position in connection with certain American installations.

We are enabled, by the courtesy of the British Thomson-Houston Company, Limited, to give a photographic view of one of the 3,500-KW. (6,600 volts) three-phase alternating current generators which have been supplied by the General Electric Company, of America, for the station of the Metropolitan Street Railway Company of New York City.

This generator has 40 poles, and is of the revolving field type. The speed is 75 revolutions per minute, and the frequency 25 cycles per second. The field of the generator is mounted directly on the engine shaft. The general method of construction follows the Thomson-Houston well-known standards, the armature core being built up of sheet iron punchings of high permeability and low hysteresis, well japanned before assembling, and further insulated from one another by sheets of paper inserted at intervals to reduce the eddy current losses. The windings are in slots on the inner side, the teeth of the core being recessed for the insertion of wooden wedges to hold the windings firmly in place. The punchings are assembled with ventilating spaces between, thus allowing free circulation of air in direct contact with the cores and windings. The coils forming the winding are completely insulated before being placed in the machine, the coils being so arranged that any one can be taken out by removing a few adjacent ones, and, in case of a burn-out, the defective coil can be readily taken out and another put in its place.

The outside frame of the armature is of cast-iron supported on slide rails so that it may be moved to one side clear of the revolving field to facilitate inspection or repair.

The magnet frame consists of a cast-steel ring with outwardly projecting poles of sheet iron, bolted to the steel ring, the ring being mounted on a substantial cast-iron spider.

The field coils consist of copper strip wound on edge, and are insulated to stand a high potential test of 4,000 volts alternating between the winding and core. The excitation E.M.F. is 125 volts. The armature windings were tested to 15,000 volts alternating.

The exciting collectors consist of two insulated rings supported on the shaft, carbon brushes being used. The overall width at right angles to the shaft is 22 feet 6 inches. The overall width of frame parallel with the shaft is 51 inches; diameter of engine shaft, 37 inches; and the diameter of field, 16 feet 9 inches.

As we write this there comes to hand an official statement made by the Manhattan Elevated Railway Company, of New York, to the effect that a contract has just been awarded to the Westinghouse Electric and Manufacturing Company, of Pittsburg, for the heavy generating machinery for the new power house, also the apparatus for sub-stations, which, with the contract already given for engines, boilers, &c., practically completes the material required for the stationary installation. The Manhattan Railway Company state that they have been actively studying the problem which to-day culminates in awarding this contract, for over two years, and have taken every possible precaution to arrive at a correct decision in this important matter. The apparatus covered by the contract consists of eight three-phase alternating current generators, each of 6,650 H.P. capacity, together with such step-down and converting devices for the sub-stations as will be necessary to transform the alternating current in the power house into direct current of 500 volts, which direct current will be fed to the third rail of the elevated system. The 6,650-H.P. generators will be the largest ever designed or constructed, their external dimensions being something over 40 feet in height, while the rotary element which includes in itself the rotary field of the generator and the necessary fly-wheel for the engine, and which will be mounted directly upon the shaft of the engine, has a diameter of 32 feet. Some idea of the enormous size of these generators may be gained from their dimensions, and from the fact that the weight of each machine and engine complete will be nearly 1,000 tons. The current generated by these large machines will be conveyed to various sub-stations conveniently placed about the city. In these sub-stations will be installed 20 rotary converters in units of 2,000 H.P. each. These rotary converters are designed to produce direct current at 500 volts for use upon the elevated structure. The first of the large dynamos is due for delivery in 10 months from date, and it is therefore thought reasonable to expect that electric trains will be running on a portion of the Manhattan system during 1900.

The selection of the engineering plans of the Westinghouse Electric and Manufacturing Company was made after much careful study by the above-named technical board, which we understand is composed of men prominent in engineering matters, who are authorities and experts in their respective lines. The action now taken by the company is considered to insure an equipment of the highest efficiency, of the most modern construction, and in magnitude second to none in the world.

* Electrical Review, September 23rd, 1898, p. 453.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 926.)

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899	one cable restored.
South African:—		
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Aden-Zanzibar	Nov. 27, 1899 ...	Dec. 4, 1899.
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Cuban Government lines... ...	Oct. 30, 1899 ...	...
Communication with Les Cayes (Haiti)	Nov. 22, 1899 ...	...
South African:—		
Communication with Mafeking...	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal...	Nov. 7, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibagua, Manizales, Medellin, Palmire, Pasto, Popoyans, Reimedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	...
Majunga-Tananaira	Nov. 25, 1899 ...	Dec. 1, 1899.
Indo-European lines between Southoun-Kalestaté-éran ...	Nov. 30, 1899 ...	Dec. 3, 1899.

Trans-African Telegraphs.—Mr. F. E. Baines, sometime Surveyor-General (Telegraphs) writes from Bournemouth to the *Times* offering a suggestion on this subject. He says:—

The Wingate victory and the death of the Khalifa promising peace and security to the Soudan south of Khartoum, and especially to the navigation of the Nile, now, in my opinion, is the time to extend the telegraph beyond its present terminus to connect the frontier posts with the centre of Government, and especially to meet the advancing wire from Rhodesia. But not by any land route. Even now casual interruptions in the desert would be easy and repairs tedious and difficult to effect. The bed of the Nile itself would be a safe resting place for an ocean pattern cable. To Fashoda the distance from Khartoum is perhaps 600 or 700 miles—a convenient length for a good cable to work without a relay station, and such a cable could be made and shipped to Alexandria by the time (or soon after) the railway opens to Khartoum. What next need not be considered now. The Nile is known to be navigable a long way beyond Fashoda, and where a gunboat can swim there can a cable be securely laid.

Wireless Telegraphy.—The *Times* Hamburg correspondent says that on November 29th, by the courtesy of the authorities at Cuxhaven and of the experts engaged in testing the system of wireless telegraphy invented by Prof. Braun, of Strassburg, a series of experiments was conducted between the shore station at Cuxhaven and the operators on board the steamship *Silvana* while *en route* to Heligoland in the presence and for the information of Colonel Hozier, C.B., of Lloyd's. The interest shown is due to the wish to adopt the most perfect communication between sea and

shore, and "it is understood that in Colonel Hozier's opinion the Braun system so far shows a considerable advance on similar experiments with other systems in England."

An evening paper says that Captain H. B. Jackson has been temporarily appointed to the torpedo ship *Vernon*, at Portsmouth, to prosecute his studies in wireless telegraphy before he is sent to the special torpedo vessel *Vulcan* to introduce the system in the Mediterranean Squadron.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast.—December 14th. The Electric Committee wants tenders for the purchase of old incandescent and arc lamps, scrap copper, iron, &c. See "Official Notices" to-day.

Birkenhead.—December 12th. The Corporation wants tenders for the supply of condensing plant, overhead crane, and feeder mains for the electric tramway works and scheme. See "Official Notices" November 24th.

Blackburn.—December 23rd. The Corporation wants tenders for overhead trolley line equipment. See "Official Notices" November 24th.

Blackpool.—December 15th. The Corporation wants for the electricity works four boilers and accessorial steam plant; two 600-KW. steam alternators (or one 1,200-KW.), switchboard, mains, transformers, and battery. See "Official Notices" November 24th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for water-tube boiler plant, steam dynamos, switchboard, and accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Gloucester.—December 28th. The Electricity Committee wants tenders for extension plant including Lancashire boiler, &c., one 300-KW. steam dynamo, switchboard work, condensing plant. See "Official Notices" November 24th.

Hackney.—December 12th. The Vestry Electric Lighting Committee is inviting tenders for refuse destructors to deal with the whole of the refuse of the parish. Specification, &c., may be obtained at the offices of Mr. Robert Hammond, M.Inst.C.E.

Hackney.—January 2nd, 1900. The Vestry wants tenders for the supply of accumulators. See "Official Notices" December 1st.

Hull.—December 28th. The Electric Lighting Committee wants tenders for two 750-H.P. high speed three-crank vertical engines; and two 460-KW. continuous current dynamos (2,250 volts) for the Sculcoates Lane electric lighting station. See "Official Notices" to-day.

Manchester.—December 16th. The Corporation Tramways Committee wants tenders for steel tie-bars, bolts and nuts for permanent way work. See "Official Notices" December 1st.

The Midland Corporation.—December 18th. From an "Official Notice" Nov. 24th, particulars may be obtained of certain plant and machinery and conductors, for 10,000 E.H.P. output, required for the new power house to be erected by the Midland Electric Corporation for Power Distribution, Limited. There will be 16 water-tube boilers, six sets of Corliss engines and three-phase generators, transformers, switchboards, mains, batteries, &c.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Plymouth.—December 8th. The Corporation wants tenders for tramcars, trucks, motors, trolley arms, &c. See "Official Notices" November 17th.

Rathmines and Rathgar.—December 13th. The Council is inviting tenders for additional feeding and distributing mains, including trenching, cables, joint boxes and house services. See "Official Notices" November 24th.

Roumania.—December 8th. The Roumanian State Railway authorities in Bucharest are inviting tenders until December 8th for the supply of 11,320 porcelain insulators and 10 tons of ingot lead.

St. Annes-on-the-Sea.—December 21st. The Urban District Council wants tenders for mains, street arc lighting (enclosed globes), and street incandescent lighting. See "Official Notices" to-day.

St. Pancras.—December 12th. The Vestry wants tenders for (*a*) two dry back marine boilers; (*b*) condensing plant, feed water heaters, steam and feed pipes. See "Official Notices" December 1st.

Trimdon Grange (Durham).—The owners of East Hetton Trimdon and Trimdon Grange Collieries want tenders for 12 months supply of iron and steel castings, gas and steam piping, and a variety of other sundries including electric light fittings. Specifications from the Storekeeper, Trimdon Grange Colliery Company.

Wallasey.—December 20th. The District Council wants tenders for a Lancashire boiler for the electricity works. See "Official Notices" to-day.

West Bromwich.—December 22nd. The Corporation wants tenders for boilers, steam dynamos and condensers, switchboard, mains, and storage battery, for electricity supply. See "Official Notices" to-day.

CLOSED.

Croydon.—The Board of Guardians has accepted the offer of Messrs. W. J. Bishop & Co., of 88, George Street, Croydon, to carry out the work tendered for at the Union Offices, Infirmary, and Workhouse for the sum of £1,995, subject to the usual conditions.

Hull.—The Electric Lighting Committee has ordered 1,000 tons of Kilnhurst best hard steam coal at 14s. 11d. per ton, for the electricity works, from Messrs. Strachan & Son.

Leicester.—The Corporation have placed an order for two 1,000-KW. steam alternators with the Brush Electrical Engineering Company, Limited. The dynamos will be of the "Inductor" type, of which a large number, both for monophase and polyphase working, are in course of construction at the Brush Company's Works at Loughborough.

FORTHCOMING EVENTS.

Friday, December 8th.—At 2.30 p.m. Institution of Civil Engineers. Students' visit to the works of the Baker Street–Waterloo Railway.

At 2.30 p.m.—Institution of Civil Engineers. Students' visit to the works of the Baker Street—Waterloo Railway, in course of construction.

At 5 p.m.—Physical Society meeting in the physical laboratory of the City and Guilds' Technical College, Leonard Street, Finsbury. "Cylindrical Lenses," by Prof. Silvanus Thompson, F.R.S.; "Exact Formulæ for Lenses," by Mr. T. H. Blakesley; "On an Organic Compound of great Double-Refraction," by Prof. Silvanus Thompson, F.R.S.

At 8 p.m.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W. "A Continuous Mean-pressure Indicator for Steam Engines," by Prof. W. Ripper.

7 to 11 p.m.—Northampton Institute (City Polytechnic) St. John Street Road, E.C. Members' and students annual conversazione.

Tuesday, December 12th.—At 8 p.m. The Institution of Civil Engineers. Paper for discussion:—"Combined Refuse Destructors and Power Plants," by C. Newton Russell, Assoc.M.Inst.C.E.

Thursday, December 14th.—At 8 p.m. The Institution of Electrical Engineers. Discussion on Mr. Crompton's and Mr. John Holliday's papers if adjourned on the 7th inst., and "Electrical Time Service," by Mr. F. Hope-Jones.

DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE eleventh annual dinner of the Institution was held on Wednesday evening at the Hotel Cecil, the president, Prof. Silvanus P. Thompson, F.R.S., in the chair. About 250 were present, the guests including Lord Kelvin, the Hon. Justice H. H. Cozens-Hardy, Sir Courtenay Boyle, K.C.B., Sir W. C. Roberts-Austen, K.C.B., F.R.S., Sir Douglas Fox, Sir Philip Magnus, Gen. Sir R. Harrison, K.C.B., Sir W. H.

White, K.C.B., F.R.S., Sir G. Murray, K.C.B., Sir H. Roscoe, F.R.S., Sir J. Crichton-Browne, F.R.S., and many other distinguished gentlemen.

The loyal toasts were proposed by the President, and were duly honoured. Mr. R. E. Crompton gave the "Navy, Army, and Auxiliary Forces," reminding the company that he himself was an old soldier, and wished he were out in South Africa—he suggested that his hearers would wish the same! Mr. Crompton's experience of the work done by the Electrical Engineers' Volunteer Corps, of which he is Major, showed what excellent results were derived from the union of military training with cultivated intelligence.

General Sir Richard Harrison, responding, in the absence of Captain Creak, R.N., F.R.S., for the Navy, as well as the Army, remarked on the admirable co-operation of the two departments in transporting troops to South Africa, and in carrying on the war inland. The so-called Auxiliary Forces he looked upon as an integral part of our military system, forming our third line of defence. A reference to the splendid conduct of the Volunteers, gathered from all parts of the Empire, in South Africa, evoked a round of cheers.

The President, exercising his prerogative, next rose to congratulate the Institution upon the presence of Lord Kelvin, who is at the very head of science in this country. He was also the head of the Clan Thomson (but without the "p.")

Lord Kelvin, who was enthusiastically received, proposed the toast of "Science." He had only to mention the word, he said, to call forth the enthusiasm and applause of engineers, to whom, on the other hand, pure science was deeply indebted. When the electric telegraph came into existence, followed, ten years later, by the first submarine cable, and ten years later still by the first Atlantic cable, electrical science was in a very backward state; an immense stimulus was given to its study by its application to telegraphy, and to the great system of electrical measurements, which originated among University professors. Gauss and Weber laid the foundation of the system, the development of which was carried out by practical engineers. He expressed profound admiration for the practical use made of mathematics by engineers; a great debt was due to the electrical journals, which published mathematical investigations freely. Excellent work is now being done by the technical training colleges, among which the University of Glasgow was the earliest to establish a Chair of Engineering.

Sir W. C. Roberts-Austen, replying to the toast, referred to the influence of the telegraph upon the maintenance of peace. Sir Henry Roscoe, who also replied, remarked that where formerly young men would have had to enter the army or navy, or to join the Church, many of them were nowadays claimed by Science. Some of the audience wondered whether Sir Henry was thinking of "Parsons'" turbines or "Vicars'" stokers!

Sir Douglas Fox proposed "Engineering," and pointed out its close connection with science. Sir W. H. White also referred to this point, as exemplified in the persons of Lord Kelvin and the late Dr. John Hopkinson. Mr. Justice Cozens-Hardy gave "The Institution of Electrical Engineers," and expatiated on the vast possibilities of electricity, which, for instance, annihilates distance, and brings news from the ends of the world, both false and true, but mostly false. The toast was coupled with the name of the President, and was pledged with musical honours. The President expressed regret at the absence of General Webber, Sir W. H. Preece, Prof. Ayrton, Colonel Huber, Mr. C. E. L. Brown, and others, and called attention to the reminder of the Swiss tour in the shape of the Exhibition of Photographs in the library of the Institution. The President also described the arrangements which are being made to organise local centres of the Institution in Newcastle, Dublin, Cape Town, and elsewhere, and invited well-to-do members to follow the munificent example of Mr. H. Wilde by contributing to the Building Fund.

Prof. Perry toasted "Our Guests" in a humorous speech, in which he invited State officials and others to consult the Institution more freely when they meet with difficult questions, while acknowledging that Sir Courtenay Boyle already did so. Sir Courtenay, in replying, offered to argue with anyone the question whether the century dies with this month, and gave useful advice to the younger members.

The proceedings terminated soon after 11 p.m.

NOTES.

Electric Car Driving.—A delightful little "Novices' Guide" to the above-named art, written by Mr. E. W. Elsley, inspector of Leeds City Tramways, and formerly a motorman himself, has reached our hands. In the preface the writer proposes "to take the novice to the car shed, show him how to bring out the car, work it during the day, together with many of the scores of things that are likely to befall him before he gets it safe into the depôt at night again." Referring to the selfish practice of some drivers, who seem to believe they know all there is to know about electric traction—and keep it to themselves—he says:—

"This is not as it should be; one man can only drive one car; no man was born with one, and no man can take one away with him when he goes" . . .

"*Power, Current, and Electricity* mean one and the same thing as far as this book is concerned."

The Guide begins with a solemn warning—

DRUNKENNESS.

"Anyone drunk when in charge of *any* vehicle is liable to three months' hard, without the option of a fine, and the driver of a tramcar deserves it." . . .

Then follows excellent advice about starting the car, varied by philosophical reflections, *e.g.*, speaking of improper operation of the controller handle—

"A so-called experienced hand will often bring it round carelessly, not making a pause on any notch, but slugger it over all of them, like one who has been turning a mangle a long time, and got tired of it."

There appears to be no detail of car driving which is unnoticed. The detection of failures is dealt with at length, the only rule for this purpose being "Look until you *do* find it."

"Are all cut-out switches in their proper place? Right home? Nothing lodging across from one to the other of them?"

"Well, now, cut out one motor, and try and work the car with the other. Won't go, eh? Well, replace that switch and try the other. . . . ."

The tricks of horse drivers and others obstructing the car or wilfully causing collisions, and the readiness of bystanders to blame the motorman, have sometimes led the author to wonder why cars were allowed to run at all. But amiable and well-disposed carters are not unknown, and are to be treated kindly.

"In fog do not travel any faster but that you can stop in the same distance as you can see. . . . You may run out of one cloud into clear weather, *then* get your speed again, but before you enter that cloud 50 yards ahead of you there, have your car well in hand again, for in that very bank there may be a man with an old broken-down pony and cart, a horse dealer with one he can't sell, fair on your track. He's waiting for a new lot, and intends getting it out of your pocket if he can, so be careful."

On frosty mornings extra sand should be carried, to help up horses which may have fallen on the track. Is not this returning good for evil? The author does not fail to give numerous instances of difficulties he has met with, and the remedies he applied. He concludes with an exhortation to all to be thorough in their work, and deprecates criticism of his style:—

"The scholar may find faults in my booklet. There are probably some errors of diction and grammar; I am no collegian, and writing is not my strong point."

The author wrote the booklet at a time when he was laid up by some mischance, and had nothing to do but read and write, and

"*this* is the result. If you think it worth the coppers, buy it; if not, don't."

We do, indeed.

Personal.—Mr. Alex. Marr notifies us that he has severed his connection with Messrs. W. T. Glover & Co., Limited, and joined the St. Helens Cable Company, Limited, as their superintendent.

The Electricity Committee of the Manchester Corporation have appointed Mr. F. E. Procter as mains engineer, at a salary of £350. The appointment is provisionally for one year only, but the prospect is held out of its being permanent. Mr. Procter will have as assistant Mr. L. R. Lee, at a salary of £185.

What Does This Mean?—We observe from a note in our New York namesake that: "At Dover, Del., on November 11th, these companies were incorporated: British Electric Street Tramway Company, to construct and operate electric street tramways in Great Britain and its colonies; capital, $5,000,000. London Electric Tramways Construction and Maintenance Company, for the purpose of constructing and operating electric street tramways; capital, $2,500,000." Our contemporary does not appear to be in the know as to the objects, &c., of these newly-formed enterprises, and in the absence of further information, comment on our part would be premature.

Up-to-Date Equipment for Printing Offices.—The new American Government Printing Offices will be provided with 12 electric elevators for access to the different floors, the buildings will be lighted by 7,000 incandescent lamps, and refuse will be destroyed for water heating. A contemporary, from which we derive this information, does not mention the electric driving of printing presses, &c., but we presume this will be part of the programme.

Obituary.—The death is announced from Abbazia of Frau Anna von Helmholtz, the widow of the distinguished Berlin professor of physics, the late Hermann von Helmholtz. Her only daughter is the wife of Herr Arnold von Siemens, the head of the great firm of electricians.

We hear with deep regret that Mr. D. Bruce Peebles, the senior partner and founder of the firm of Messrs. D. Bruce Peebles & Co., died on Tuesday morning. Mr. Peebles was perhaps one of the best known men in the gas world for the last 30 years, and it redounds to his broad-minded spirit that, in face of this fact, he, two years ago, started the electrical manufacturing department, which, despite the short time it has been established, is already one of the largest in the country. His advancing years notwithstanding, Mr. Peebles took the greatest interest in each succeeding development of the new department, and although originally brought up in the old school, was ever a staunch supporter of the latest improvements. It is a consolation to think that he lived to see the success of his labours firmly established.

Correction.—In an article on "Electric Railways in America" in our issue of November 10th, we referred to a special issue of the *Street Railway Review*, upon an article in which our comments were based. We regret, however, that the name of the journal was given incorrectly. The issue referred to was the "World's Practice Number" of the *Street Railway Journal*.

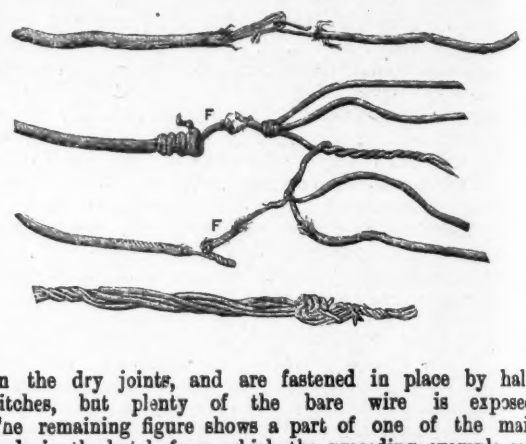
Appointments Vacant.—For the Whitechapel electricity undertaking a mains foreman, shift engineer, and other members of staff are required. See "Official Notices" this week.

The Bury St. Edmunds Corporation wants a resident electrical engineer at £150 per annum. See "Official Notices."

The Manhattan Railway Generators.—The halfpenny daily press, in its efforts to manufacture sensational headings, sometimes overshoots the mark, and makes itself very ridiculous. A case in point is just found in the *Daily Mail* columns. In recording the placing of the Manhattan large generator contract with the Westinghouse Electric Company, "which is about to erect extensive works at Manchester," the paper in question heads the note, "Trade comes to England!" From this, the ordinary reader would gather that these enormous generators are to be made in this country, but such is certainly not the case. The Manchester works are hardly likely to be opened for some little time yet, and the first of these 6,650 H.P. sets is promised for delivery in 10 months.

Lecture.—At a meeting of the Liverpool Engineering Society last week, Mr. A. Lester Taylor read a paper on the "Fire Risks of Electrical Installations." The chair was taken by the president, Mr. A. Bromley Holmes, and there was a large attendance of members.

Jerry Wiring.—The first of the annexed figures shows what is probably the worst attempt at a "joint"—save the mark—that we have ever met with. This extraordinary connection was covered with a strip of chair-webbing, laid lengthways, a rag of flannel, and a strip of similar material rolled many times round the bundle, and dabbed with red paint. The next figure shows the wiring of a three-light ball fitting, the letters, F F, distinguishing two bits of flexible of small size, which unite the branches with the main leads; pieces of India-rubber tape are lavished



on the dry joints, and are fastened in place by half-hitches, but plenty of the bare wire is exposed. The remaining figure shows a part of one of the main leads in the hotel, from which the preceding example was obtained. The 7×18 cable is roughly dry-jointed to a 7×23 cable, which latter had to carry the whole current for lighting the hotel. When this "joint" was uncovered it was actually *red-hot*, and all the tin had been burnt off the copper wires! When will something be done to bring such criminal work within control of the law? The perpetrator of such misdeeds ought to be liable to penal servitude, and the contractor who allows such work should take his place beside him.

Royal Society.—On November 30th the anniversary of the Royal Society was held at Burlington House. Lord Lister delivered his anniversary address. In the evening the annual dinner was held at the Hôtel Metropole, Lord Lister again presiding.

Swiss Photographs.—The secretary of the Institution of Electrical Engineers informs us that the collection of photographs taken by members during the recent visit of the Institution to Switzerland were placed on exhibition in the library on Tuesday, 5th inst., and they will remain so until Tuesday next, 12th inst.

Northampton Institute.—Mr. E. Kilburn Scott has been recently appointed to the post of instructorship in electrical engineering and design.

Royal Institution.—The Goldsmiths' Company has made a further grant of £1,000 for the continuation and development of original research, and especially for the prosecution of further investigations of the properties of matter at temperatures approaching that of the absolute zero of temperature.

Presentation.—On Wednesday last week, at a meeting in the Lecture Theatre of the Victoria and Albert Museum, very numerously attended by members of the present and past staff of the department and by men of Science and Artists who have been connected with it, Sir John Gorst presented on the behalf of some 500 subscribers, a testimonial to Major-General Sir J. F. D. Donnelly, K.C.B. This consisted of a silver salver, a set of library furniture, a collection of books of reference, a Zeiss binocular, and a diamond brooch for Lady Donnelly. The inscription on the salver stated that it was a recognition of high regard and in remembrance of cordial relations of more than 40 years.

The Possibilities of Electricity.—At a meeting of the Railway Institute at Darlington last Friday evening, Sir James Kitson, M.P., a director of the North-Eastern Railway Company, in the course of his address, went on to comment on the development of electricity in the United States. They were many years ahead of us, he said, because of the scientific attainments of the American people. The way in which electricity was being developed and applied was one of the great things of the future, to which the young men of the present day should particularly turn their attention. Just now the great firm of Westinghouse, of Pittsburg, had arranged to erect works at Manchester for the production of electrical machinery. There was no difficulty with us in finding workmen who would follow the instructions of the foreman, but we had a difficulty in finding the young scientists who would instruct the men, and show how the machinery should be produced. Men were being brought over from the United States to establish these works. We in England ought to be able to do these things for ourselves. It was simply a question of education. In Sweden, where he had lately been, they were becoming independent of coal, and he had seen great ironworks driven entirely by adjoining water-power converted into electricity. From one of the Scottish lochs there was available 40,000 H.P. daily which was now passing away to the sea. Brilliant opportunities were now opening to the new generation.

A Woman of No Importance.—"Meteor" says that the word "Aerogram," if used as a name for wireless telegraph messages, is certain to be mispronounced. "Who does not know ladies who invariably speak of an *areated* bread shop," remarks the earthly embodiment of the Leonids. This shows the kind of female society *he* affects!

Fatality.—Last Saturday an inquest was opened at Willesden into the death of A. J. Barnes, 22, who met his death on 29th ult., at the new works of the Metropolitan Electric Supply Company, where he was employed as engineer. Somehow or other deceased fell among the moving parts of one of the large machines, and was torn to pieces. The hearing was adjourned for the attendance of the Home Office inspector in regard to the protection of the machinery.

NEW COMPANIES REGISTERED.

Newhaven and Seaford Electric Lighting Company, Limited (64,307).—This company was registered on November 25th, with a capital of £20,000 in £1 shares, to carry on the business of an electric light company, electrical engineers, electricians, suppliers of electricity for all purposes, telephone, telegraph and general contractors, engineers, wire and cable manufacturers, &c. The subscribers are:—A. J. Jack, The Crouch, Seaford, civil engineer, 50 shares; J. F. Plaister, Highlands, Seaford, manufacturer, 50 shares; J. A. M. Bannister, Lorraine, Newhaven, draper, 50 shares; A. G. Mossop, Wiegland, Newhaven, M.D., 20 shares; E. J. Gorringe, Chynton, Seaford, farmer, 50 shares; W. P. Morgan, Hurdie House, Seaford, M.B., 50 shares; Rev. H. H. Goodwin, Bonnewell, The Vicarage, Seaford, 50 shares; and E. Towner, Steam Mills, Newhaven, miller, 50 shares. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration, £25 each per annum and a share in the profits.

Atlas Engineering Company, Limited (64,320).—This company was registered on November 27th, with a capital of £2,000 in £1 shares, to acquire the business carried on by Benjamin Wild and John H. Clarke, under the style or firm of "Wild, Rothwell and Co.," at Atlas Works, Virginia Street, Southport, and to carry on the business of electrical and mechanical engineers, ironfounders, cycle, motor, motor car, and motor cycle manufacturers, carriage builders, &c. The first subscribers (each with one share) are:—Nicholas T. Pollitt, Lansdowne Villa, Sheffield Road, Godley, engineer; James Malam, 21, Sefton Street, Southport, gentleman; Thomas Pendlebury, 16, Ivy Street, Southport, engine driver; John R. Haworth, 4, Norwood Avenue, Southport, accountant; James B. Davenport, 73, Ridley Lane, Hyde, printworks manager; James Hall, 8, Lathbridge Road, Southport, mineral water manufacturer; and Mrs. Alice Pendlebury, 16, Ivy Street, Southport. The number of directors is not to be less than three nor more than five; the first are James Malam, Nicholas T. Pollitt, and Thomas Pendlebury; qualification, 50 shares; remuneration as fixed by the company. Registered office, Atlas Works, Virginia Street, Swansea.

Rotary Piston Engine Company, Limited (64,327).—This company was registered on November 28th, with a capital of £2,000 in £1 shares, to acquire the British, Foreign and Colonial rights in patents Nos. 5,086 and 20,332, both of 1899, and to carry on the business of engineers, electricians, &c. The first subscribers (each with one share) are:—A. Binnie, 9, Warwick Court, Gray's Inn, W.C., engineer; A. E. Vidal, 20, Central Hill, Norwood, S.E., law student; W. Everett, 9, Warwick Court, Gray's Inn, W.C., draughtsman; J. M. Langdon, 80, Beaufort Street, Chelsea, S.W., gentleman; C. S. Mole, 17, Kenton Road, South Hackney, clerk; J. Starey, 37, Cursitor Street, E.C., agent; and E. J. V. Davis, 11, Harringay Villas, Green Lanes, N., ironfounder. Registered without articles of association.

County of Sussex Electrical Power Distribution Company, Limited (64,333).—This company was registered on November 28th, with a capital of £50,000 in £10 shares, to carry on the business of electrical engineers, electricians, engineers and contractors, suppliers of electricity, manufacturers of electrical apparatus, mechanical and chemical engineers, tramway and light railway proprietors, wharfingers, warehousemen, &c. The first subscribers (each with one share) are:—J. Renwick, 29, Hillside Road, Stamford Hill, N., clerk; M. E. Sheerhoom, 6, Ferncliffe Road, N.E., clerk; C. Walmsley, Donington House, Norfolk Street, W.C., accountant; E. Hopwood, 35a, Hertford Street, Mayfair, W., clerk; W. L. Madgen, 47, Lower Belgrave Street, S.W., electrical engineer; R. P. Sellon, Queen Anne's Mansions, Westminster, electrical engineer; and J. S. Raworth, 2, Queen Anne's Gate, S.W., civil engineer. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company. Registered office, Surrey House, Victoria Embankment, W.C.

Llanelly and District Electric Lighting and Traction Company, Limited (64,341.)—This company was registered on November 29th, with a capital of £50,000 in £1 shares, to carry on the business of an electric light company in all its branches, and in particular to construct, lay down, establish, fix, and carry out all necessary cables, wires, lines, accumulators, lamps, and works, to generate and supply electricity for all purposes, to light towns, streets, markets, theatres, shops, houses, buildings, and places, to erect destructors for dealing with refuse, and to manufacture and deal in chemical and other substances obtained therefrom. The first subscribers (each with one share) are:—Wm. M. M. Forwood, 15, Union Court, Liverpool, solicitor; Chas. O. Grindrod, 11, Knowsley Road, Rock Ferry, Cheshire, solicitor; Albert E. Haptie, 5, Durham Road, Seaforth, near Liverpool, manager; Fredk. W. Lintern, 22, Beaumont Street, Liverpool, book-keeper; Allen Buckley, 8, York Road, Seacombe, Cheshire, book-keeper; Herbert J. Russell, 25, Demesene Street, Seacombe, Cheshire, book keeper; and John Hayes, 113, St. James Street, Liverpool, book-keeper. The number of directors is not to be less than two nor more than five; the first are to be appointed by the subscribers; qualification, £100; remuneration as fixed by the company.

Electrolytic Alkali Company, Limited (64,360).—This company was registered on November 30th, with a capital of £500,000 in £1 shares (2,000 preference), to enter into agreements with the General Electrolytic (Parent) Company, Limited, Charles O. Connor and Douglas Hermann, to manufacture alkali, chlorine, bleaching powder, and other chemical substances by electrolysis or otherwise, and to carry on the business of soap and chemical manufacturers, electro-metallurgists, &c. The first subscribers (each with one ordinary share) are:—Charles O. Connor, 4, Queen's Elms, Belfast, merchant; William Thomson, Royal Institution Laboratory, Manchester, consulting chemist; James A. Morrice, 124, St. Vincent Street, Glasgow, manufacturing chemist; W. T. Thomson, Ghyllbank, St. Helens, Lancs., copper smelter; A. Weilson, 6, Chapel Street, Liverpool, general produce broker; W. Varley, St. Annes, St. Helens, Lancs., bank manager; and John Wilson, Oxford Road, Runcorn, chemical engineer. The number of directors is not to be less than three nor more than nine; the first are John Barr, Alfred E. Fletcher, Zachariah J. Heys, John A. Morrice, William Thomson, and two others to be nominated by the General Electrolytic (Parent) Company, Limited; qualification, £500; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Monte Video Telephone Company, Limited (27,208).—This company's annual return was filed on November 13th, when 86,492 preference, and 72,680 ordinary shares had been taken up out of a nominal capital of £160,000 in 87,000 preference, and 73,000 ordinary shares of £1 each. £159,172 is considered as paid.

Brush Electrical Engineering Company, Limited (29,533).—This company's annual return was filed on October 24th, when 90,000 ordinary and 90,000 preference shares had been taken up out of a nominal capital of £660,000 in 180,000 ordinary and 150,000 preference shares of £2 each. £360,000 has been received.

East Grinstead Electrical Lighting Company, Limited (48,522).—This company's annual return was filed on November 6th, when seven ordinary shares were taken up out of a nominal capital of £15,000 in 5,000 preference and 10,000 ordinary shares of £1 each. No calls have been made.

SUPPLY STATION ACCOUNTS.

Leyton Urban District Council Electricity Accounts.

The accounts of the Leyton Electricity Supply Undertaking are interesting as showing what can be done with gas power. The price charged is low, being 5d. and 3d. per unit for lighting, and 3d. for "power and heat." The late engineer, Mr. H. Collings Bishop, is now engaged in designing works for the Wigan Corporation. The first of the accounts analysed below is signed by him, and the second by his successor, Mr. F. Harman Lewis, who gained valuable experience at Wolverhampton in the early days of the supply there, for which he was principally responsible.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£28,247	£47,047	£18 800
Number of units sold	123,797	248,905	125,108
Number of lamps connected ...	6,788	13,644	6,856
Gross revenue	£1,802	£3,417	£1,615
Gross profit	£466	£926	£460
Average price per unit sold ...	3·14d.	3·26d.	·12d.

The units sold have more than doubled, and the gross profit has almost exactly doubled, but it will be noticed below that the sum required to meet interest and sinking fund has risen still more rapidly, being about £1,200 in 1897 and £1,850 in 1898, or an increase of £650 against an available additional sum of £460 in the gross profits. The result is that the net deficiency has risen from £730 to nearly £930, or almost £200 increased loss. Notwithstanding low "costs" there is every indication that this deficiency can only be met by charging a price higher than that so far asked. One may say that like other undertakings of similar size the Leyton supply has attempted to create a quick and large demand by charging an inadequate price.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£1,622	3·14d.	£3,375	3·26d.	+·12d.
Meter rents	21	·04d.	83	·08d.	+·04d.
Supply of fittings, &c.	109	·21d.	−76	−·07d.	−·28d.
Sundry	50	·10d.	35	·03d.	−·07d.
Gross revenue	£1,802	3·49d.	£3,417	3·30d.	−·19d.

It appears, on analysis of the printed accounts, that, notwithstanding the revenue from sale of current being nearly an eighth of a penny greater than in 1897, the gross revenue per unit has dropped by nearly one-fifth of a penny. This is accounted for by the unusual item of a loss on supply of fittings, which exceeds ½d. per unit.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal and other fuel	£266	·52d.	£703	·68d.	+·16d.
Oil, waste, water, and engine room stores.	48	·09d.	119	·11d.	+·02d.
Salaries and wages incurred in generation and distribution.	722	1·40d.	905	·87d.	−·53d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	19	·04d.	193	·19d.	+·15d.
Work,' cost	£1,055	2·05d.	£1,920	1·85d.	−·20d.
Rent, rates and taxes ..	...	...	1	...	...
Management and expenses, salaries of managing engineer, secretary, clerks, &c.	281	·54d.	350	·34d.	−·20d.
General establishment charges, stationery and printing, law charges and insurance	...	...	220	·21d.	+·21d.
Other expenses	...	...	...	...	...
Total costs ...	£1,336	2·59d.	£2,491	2·40d.	−·19d.

The costs are exceptionally favourable. Low as they were in 1897, a further reduction of one-fifth of a penny has been made in both "Works'" and "Total" costs, and this in spite of the much increased coal bill per unit, and the new item of establishment charges. Leyton is fortunate in being able to meet "Rent, &c.," with the sum of £1 sterling annually. Many engineers will wish similar leniency was meted out to their undertakings.

Profit Statement.

	1897.	1898.
Interest on loans	£578	£861
Sinking fund for repayments	625	993
Net profit carried to rates	−737	−928
Gross profit	£466	£926

CITY NOTES.

The Allgemeine Elektricitäts-Gesellschaft.

The seventeenth annual general meeting of this company was held in Berlin on November 30th last. The board was able to recommend a dividend of 15 per cent. for the business year 1898-1899, on a capital which was 17 million marks greater than last year. The increase of capital decided on in May last has enabled the company to purchase several electro-chemical businesses.

The manufacture of small motors has been separated from the general machine factory, which had to work overtime to carry out the great increase of business. 11,438 machines, of 197,689 H.P., were manufactured, as against 8,328, of 152,900 H.P.; amongst these were dynamos of 4,000 H.P. and motors of 1,000 H.P. The simplicity of construction of Drehstrom machines, and their high efficiency, has brought them into great favour, especially in all industries on a large scale, such as mining and smelting works, while the direct current appears to be limiting itself to lighting and traction in densely built cities.

The cable factory has been affected by the anomalous condition of the copper market. The other materials, such as rubber, gutta-percha, lead and silk, have also shown an upward tendency. Yet the turnover in this department has been double that of last year, and the number of workmen has increased by 25 per cent. The rise in the price of copper has led to trials with aluminium wire, which promise favourable results.

The glow lamp factory has increased its production by a million lamps. As soon as the required workshops are erected, a trial is to be made of the technical and economical value of the Nernst lamp by supplying the numerous orders already in hand. The principal patent has been granted by the German Patent Office, and all the European patents, except those for Austria-Hungary, Italy, and the Balkan States have been secured by this company.

At the end of the last business year there were 65 electric tramlines of this company's system at work or in course of construction. For the new account, contracts have been signed or prepared for 35 new lines.

Apart from the great works carried out for the Berlin electricity works, 19 electricity works of about 40,000 H.P. have been completed and are now at work, while 34 more of 80,000 H.P. are in course of construction. The great power transmission works at Rheinfelden have been completed in the past year. Details are given of the working of numerous companies associated with the Allgemeine Elektricitäts-Gesellschaft. The sole representatives of this prosperous company in this country are the Electrical Company, Limited, 122 and 124, Charing Cross Road.

Kalgoorlie Electric Light and Power Company.

On Monday last, Mr. R. W. Wallace, Q.C., presided at the statutory meeting of this company at Winchester House.

The Chairman said that there was little to report, as in the four months it was not possible for the directors to have achieved very much. The objects of the company were thoroughly set out in the prospectus. The company was incorporated on August 8th, 1899, and went to allotment on September 15th, 1899. The whole of the issue of £150,000 6 per cent. cumulative preference shares were allotted, and 5s. per share had been called up and practically all paid. There were 547 shareholders, most of whom were interested in the mines in their district. Nearly the whole of the mining properties in Kalgoorlie were situated within a radius of 1½ miles from the central station. That was exceedingly favourable from the point of view of distribution. Some of the London electric lighting companies had to go to a far greater distance than that. Their business was different to that of lighting companies, because such concerns only gave a supply for a few hours a day, except at times of fog, and they had to have their whole plant available for the supply of those few hours. The plant remained idle for a very large part of the 24 hours. But in the supply of current to mining industries such as this, the power was wanted for practically the whole 24 hours, so that the plant might be working continuously. The supply of electricity for power purposes had been very much on the increase during the past few years. Most factories, even where coal was very cheap, found it better; instead of taking their power by belts and pulleys they preferred to convert to electrical systems, so that they might get a supply of power readily, continuously, close to the machine, and do away with intermediate transmission. The mining experts had seen that that was almost a necessity for them, and that was why such a company as this had been so favourably received by the mine managers. The chairman gave names of well-known mines within their radius. If a mining engineer found for any reason that his pumps ceased working or if the power was not supplied continuously for his various operations in gold getting, his output fell very considerably short, and in order to prevent this he must have duplicate supplies. That was almost impossible in those large mining companies. It would be too costly for them to keep plant idle, and it was a combination of this kind which was manifestly a great advantage to them, inasmuch as keeping one spare unit enabled the whole district to take power supply which would not fail. When the directors took charge of the company they had to face the reports of various electrical engineers, and there was a great deal of difference in their estimates, and also a great divergence of opinion as to the best means of carrying out the work. They, therefore, decided not to fix upon any system in detail until they had seen Mr. Callender, of Lake View mines, and Mr. Cook, who had superintended the erection of the Perth tramways. They had seen these two gentlemen in London recently, and

had received very valuable information and suggestions from them. The plans were nearly all prepared. He (the speaker) on reading the reports, came to the conclusion that ultimately the power would be produced by means of gas engines, but they must not experiment. They had not had sufficient experience of the working of large gas engines at present. They had been at work at Brunner Mond's, and in the Westinghouse Company's works, but they had not been sufficiently experimented upon to warrant the company using them as a source of supply at first. The board was having experiments made, and when they came to future extensions gas engines would no doubt be adopted. The reason that gas would be cheaper than steam power was the nature of the water supply at Kalgoorlie. The water was very largely impregnated with salt, and if used for condensing engines there was a very large expenditure in getting water for that purpose. In cooling gas engines, they could use the salt water without any condensation, and get a very much more economical rate of working. He (the chairman) believed that with the use of gas engines they could save on annual expenditure something like £30,000 a year. The experiments being made were not at the company's expense, but it was necessary that the system should be thoroughly investigated for the future. At present they were contemplating putting down 4,000 H.P. plant, and they hoped that would be got to work in the course of a year, but the details of the plans had had to be considerably modified from those originally placed before the directors in the schemes of the engineers. They were convinced that it was absolutely necessary that they should supply compressed air as well as electricity. They had found from inquiries that electrical drills were not at present in a position to be used; drills had to be driven by compressed air. There was not the slightest doubt that the amount of power which they originally expected to supply would be exceeded, as the mine managers were only too anxious to get it. The company had experienced mining men on the board, an excellent local board, and they had under their consideration the appointment of managers. Inquiries to that end had been made in America and Germany, and appointments would shortly be made.

In reply to questions, the CHAIRMAN said that they were not bound by the syndicate in the matter of tenders; they had a free hand. In order to get proper tenders the plans, &c., must be completely finished. The very slight delay in sending out for tenders would save the company a good deal of money in the end. A great many provisional contracts had been entered into, but they did not care to enter into binding contracts until they had the power to deliver. The coal obtainable had not been looked upon favourably for the purpose of making gas. They were making investigations as to gas production. It would be impossible to put down large gas works, so that one of the cheaper forms of gas would have to be used.

The India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.

THE directors' report for the nine months ending September 30th, 1899, to be presented at the meeting at Cannon Street Hotel, London, on Thursday, December 14th, reads:—"The annexed accounts show, after provision for doubtful debts, a net profit for the past nine months of £43,616 5s. 7d. Adding £25,395 3s. 3d. brought forward, and deducting £12,500 interim dividend paid in July, there remains a disposable balance of £56,511 8s. 10d. The directors recommend the distribution of a dividend of 10s. a share, free of income-tax, amounting to £25,000, making, with the interim dividend paid in July, a total payment at the rate of 10 per cent. per annum, and leaving £31,511 8s. 10d. to be carried forward. The general business has been fairly profitable, the selling prices of goods having been increased to meet the advance in the cost of the raw materials. The cable vessels have been moderately employed. The *Dacia* completed the laying of a short cable which the company had manufactured for the International Ocean Telegraph Company of New York. As the period under review was closing, the company concluded a contract with the Commercial Cable Company for the making and laying of a cable which will connect Canso, Nova Scotia, with New York. This cable will be laid by the *Silvertown* next year. The works at Silvertown and Persan have been maintained in their usual state of high efficiency. The board record, with deep regret, the loss they have sustained through the death of Mr. F. L. Hutchins, who had been their legal adviser for 32 years. Mr. Robert Kaye Gray has been elected a director of the company. Mr. Marsham and Mr. Jarvis, the directors retiring by rotation, offer themselves for election."

The Cape Electric Tramways, Limited.

THE ordinary general meeting of the shareholders of this company was held on Thursday of last week at Winchester House, Old Broad Street, Col. Sir Charles Euan-Smith, K.C.B., &c., presiding.

The CHAIRMAN, in proposing the motion for the adoption of the report, said he felt that he might again, on behalf of the board, congratulate the shareholders upon the results of the past year's working. In the year under review, after making full provision for debenture interest, they had been able to pay the shareholders 6½ per cent. upon their capital, as against 5½ per cent. last year. They had placed £8,000 to the credit of the reserve fund, as against £2,000 in 1898, and they were still able to carry forward between £15,000 and £16,000 to the next year's account. Had the board considered it wise and prudent, a still further dividend of 2½ or 3 per cent. could have been paid, but the directors considered that they were best serving the interests of the shareholders by not dividing all that could possibly be divided. The circumstances of the time were such that they demanded conservative and cautious treatment of the resources of the company. The object of the board was to do everything they could to place the future of the company upon a sure and sound basis, so that they might be prepared, as far as possible, for any unforeseen circumstances that might occur. He hoped that that policy would have the approval of the shareholders. The company was, he was glad to say, progressing They carried 1,602,720 more passengers last year than they did in the preceding year, and he might mention that in the month of October this year the tramways, both at Cape Town and Port Elizabeth, had established a record, as for that month they received no less than £14,635, whereas the highest takings hitherto recorded for any single month since the company had been established was £13,180. Of course, the situation existing at the present time, both in Cape Town and Port Elizabeth, was very favourable for passenger traffic on their lines, but he did not think there was any reason to anticipate for South Africa generally anything but marked prosperity and advancement. As regarded the action now pending between the Eastern Telegraph Company and themselves, it was impossible for him to say much regarding a case that was still *sub judice*. He might, however, state that the directors believed they had a complete answer to the extravagant claim for damages which the Eastern Telegraph Company had brought against them. They were conscious of having done everything they possibly could in order to avoid litigation, and they were informed that in America, where very similar cases had been tried, in no single instance had a verdict been given against the tramway companies. They had taken every step necessary to ensure their case being properly represented, and they awaited with confidence the decision that would be given.

Vice-Admiral MARKHAM seconded the motion.

The CHAIRMAN, in answer to a SHAREHOLDER, said that the Eastern Telegraph Company's claim was for damages, based on the allegation that the action of their electrical tramways disturbed the action of their cables.

The report was then adopted.

The directors and auditors having been re-elected the proceedings terminated with a vote of thanks to the chairman for presiding.

Electric Street Car Syndicate.

THE annual meeting of this syndicate was held last week at the works of the syndicate in Withersfield Road, Wolverhampton. The chair was occupied by Mr. Thomas Parker, J.P. The proceedings were of a purely routine and private character, and passed off satisfactorily. The syndicate, it is stated, is initiating a new method of working tramways, a system which it is claimed has great promise for the future. The company is also in an excellent position to supply electric motor cars.

Prospectus.

THE list of applications closed yesterday in the English Electric Manufacturing Company, Limited, which has been offering for public subscription £125,000 4½ per cent. first mortgage debenture, and 37,000 £5 6 per cent, cumulative preference shares. The total share capital of the concern is £385,000 (40,000 ordinary, and 37,000 preference, all £5 shares). The whole of the ordinary shares are issued to the vendors in part payment of the purchase money. The undertaking and works of the company are referred to on another page of this issue, from which it will be seen that there is great scope for the company's operations in traction work. The whole of the debentures mentioned above are to be reserved for working capital. The prospectus gives particulars of the agreements entered into with S. H. Saort, the Equipment Syndicate, Limited, Dick, Kerr & Co., and others, quotes facts and figures showing the amount of work in hand and in prospect, details the capacity of the works, and prints a report by Mr. Stephen Sellon, of Westminster, and Mr. William Wilson, surveyor and valuer, Manchester, stating the value of the property to be acquired from the Equipment Syndicate (who are the promoters and vendors) is £306,805. The directors, are:—Richard Henry Prestwich (director Blackpool and Fleetwood Tramroad Company), Manchester, chairman; George Flett, 110, Cannon Street, London, E.C.; John Kerr, 94, George Street, Edinburgh; Thomas Dewhurst Lingard, Booth Street, Piccadilly, Manchester; George Richardson (chairman North Metropolitan Tramways), London; Sidney H. Short, 110, Cannon Street, London, E.C. (technical director). The secretary (*pro tem*) is Mr. Fredk. Crimes, 13, Spring Gardens, Manchester.

Venezuela Telephone and Electrical Appliances Company, Limited.

ON Thursday last week a meeting of this company was held at 28, Victoria Street, S.W., Sir Douglas Fox presiding.

The CHAIRMAN said that fair progress had been made with the company's business during the year. Good relations had been maintained with the Central Government and the municipalities of the various towns with which they were connected. There had been very few complaints in regard to the working of the telephonic system. The company had been passing through rather troublous times, the trade of Venezuela having been bad owing to the low prices of coffee, and other circumstances. For the year ended June 30th last, the accounts showed a profit of £9,079, excluding £699 brought forward. After providing for the interest on the first and second debentures, &c., and the dividend on the preference shares, there remained £4,532. Out of this sum the directors recommended a dividend on

the ordinary shares at the rate of 2 per cent. per annum, which would absorb £1,400; the writing off of the expenses in relation to the new contract, £1,103, and the transfer of £1,500 to reserve, leaving £531 to be carried forward. The number of subscribers increased from 2,640 to 6,691, while the capital outlay was £1,302, against £1,754 during the previous financial year. The whole of the plant, machinery, &c., had been maintained in good working order and repair out of revenue, and the company's position was gradually becoming consolidated, so that better results might be hoped for in the future.

The report was adopted.

Southern Electrical Installation and Wiring Company.

The statutory meeting of this company was held on Friday at Hastings, Captain Colvile presiding. The Chairman, in his speech, said that the directors had completed the purchase of the businesses, and had had the accounts for the first three months of the company's working gone through by the company's professional auditor. He was glad to be able to tell them, as they would be glad to hear, that the books showed a considerable margin of profit. They had between 30 to 40 shareholders, who had taken up 1,855 preference and 3,493 ordinary shares. Application for free wiring concessions had been made in a neighbouring town, but the matter was not yet settled.

The Electric and General Investment Company, Limited.—The directors have declared an interim dividend of 10 per cent. on the capital paid up on the ordinary shares of the company, being 2s. per cent., less income-tax. The dividend is for the six months ended the 30th ult., and will be payable on the 20th inst. to those shareholders registered on the books of the company on November 30th, 1899.

Brazilian Submarine Telegraph Company, Limited.—The directors have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income-tax, for the quarter ended September 30th last, and payable on December 21st. The transfer books of this company will be closed from December 14th to 20th, both days inclusive.

Stock Exchange Notices.—The Stock Exchange Committee have appointed special settling days as under:—Wednesday, December 13th—New General Traction Company, Limited—Further issue of 20,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 54,001 to 74,000.

British Columbia Electric Railway Company, Limited.—An interim dividend at 4 per cent. per annum (tax free) has been declared on the ordinary shares for the six months to September 30th.

British Electric Traction Company.—The letters of allotment in respect of the issue of 20,000 preference shares have been issued.

The Electric Lighting and Traction Company of Australia, Limited.—The first ordinary general meeting of this company will be held at Winchester House on Monday, 11th inst., at 12.0 noon.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 2nd, 1899, were £161 16s. 0d.; December 2nd, 1898, £143 8s. 3d.; aggregate for half-year to date, £19,787 13s. 0d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending December 1st, 1899, were £2,696 11s. 10d.; corresponding period, 1898, £2,478 5s. 0d.; increase, £218 6s. 10d.

The City and South London Railway Company.—The receipts for the week ending December 3rd, 1899, were £1,053; December 4th, 1898, £1,119; decrease £66. Total receipts for half-year, 1899, £22,540; total receipts corresponding period, 1898, £22,636; decrease, £96. Miles open, 8¼.

The Dover Corporation Tramways.—The receipts for the week ending December 2nd, 1899, were £154 10s. 3d.; December 3rd, 1898, £140 14s. 4d.; increase, £13 15s. 11d. Total receipts to date, 1899, £9,462 14s. 2d.; corresponding period, 1898, £7,927 2s. 2d.; increase, £1,535 12s. 0d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,783; 1898, 4,222. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, December 1st, 1899, were as follows:—D. U. T. Co., horse cars, £173 14s. 1d.; ditto, electric cars, £2,753 14s. 2d.; D. S. D. Co., electric cars, £665 6s. 6d.; total, £3 591 14s. 9d.; corresponding week last year—D. U. T. Co., horse cars, £1,891 9s. 0d.; ditto, electric cars, £498 5s. 9d.; D. S. D. Co., electric cars, £497 7s. 8d.; total, £2,887 2s. 5d.; increase, £704 12s. 4d. Aggregate to date, £92,833 8s. 7d.; aggregate to date last year, £88,186 4s. 1d.; increase to date, £4,697 4s. 6d. Worked:—The mileage open is 39 miles electrically, 5 miles by horses, as against 16 miles electrically, and 26 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending December 3rd, 1899, were £576; December 7th, 1898, £236; Increase, £340. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £21,196; 1898, from June 29th, 1898, £6,067. Miles of track open, 12; 1898, 8¼. Car miles run, 12,024; 1898, 4,084.

The Liverpool Overhead Railway Company.—The receipts for the week ending December 3rd, 1899, amounted to £1,747; corresponding week last year, £1,317; increase, £430.

The South Staffordshire Tramways Company.—The receipts for week ending December 1st, 1899, were £701 8s. 7d.; December 2nd, 1898, £610 14s. 3d.; aggregate receipts for 48 weeks £31,980 10s. 11d. 1898, £30,349 16s. 4d.

STOCKS AND SHARES.

Wednesday Evening.

Again our report has to tell of the downward path pursued by electrical stocks and shares. The changes are, however, few and unimportant, except as regards two or three stocks, and, on the whole, the market has up to the present escaped lightly under the wave of depression that is threatening other departments of the Stock Exchange. Dear money is at the root of the trouble, and apprehensions with regard to the Bank rate are causing anxiety in every direction. Investment and speculation both lie dormant under the dark horizon, nor is it likely that business will return to any appreciable extent until after the new year, when there may be less difficulty in the money market.

In the supply section there is a widening in the quotation for City of Londons, which gives them an air of being ¼ up, but the improvement is more nominal than real. It is interesting to note, in these days of new developments, that the City Company has the power of issuing another £200,000 worth of ordinary share capital, while its great rival, the Charing Cross and Strand, would have to appeal to Parliament before raising fresh money, as its authorised powers have all been exercised. The Metropolitan Company has a further 15,000 shares of £10 each in reserve, besides Debenture Stock to the amount of £30,000. "Mets." are a weak market, and it is feared that the enterprising Marylebone Vestry may introduce a fresh element of discord into the protracted negotiations now going on between itself and the company by allowing a competitor to enter the parish. The proposal is down on the minutes of the Vestry, together with another which suggests the purchase of the company's interests in Marylebone, which, by the way, the company values at the sum of £933,211!

South Londons are now fully paid, and the fact that there is no liability upon them may help to keep the price steadier than it has hitherto been. Westminsters are a dull spot and have lost another 10s., making £1 within the last fortnight. Blackheath and Greenwich are ⅜ to 1, and Aron Meter are ⅜ ex the dividend of 7½d.

Welsbach Incandescent stocks are receiving some attention upon the reported perfecting of the company's invention for applying the system to electric lights as well as gas. The advantages claimed comprise much greater economy in burning, much greater power in illuminating, and the others connected with the familiar gas lighting arrangement. If the new invention proves practicable, it will result in a nice little bonus falling to Welsbach stockholders, whose spirits have lately moved downwards as the stocks fell day after day. The Ordinary stock now stands at 64 and the 5 per cent. Preference at 73, the latter appearing to be the more desirable investment.

The telegraph market shows most fall on the week of any of the electrical sections. Eastern Ordinary has shed a brace of points, the Preference and Debentures stocks one each. "Chinas" are also weaker, both as regards the shares and Debenture stock, the continual delay on the wires and the strict Press censorship are causing a good deal of disappointment to a market which has only lately recovered from a severe blow. Moreover, Eastern stock is being sold by "bulls," who bought in anticipation of the company doing a roaring business over the war, and who are getting weary of the constant "pin-pricks" to which their company is subjected. Dear money also operates powerfully in the stock's disfavour. The Anglo group is also dull and flat, due to the money scare that is agitating Wall Street. Submarine Cables Trust is down a point, holders of the old selling their stock in order to take up the new issue. West India and Panama are quoted ex-dividend, but so far from recovering the amounts, the Ordinary and Preference have suffered to the extent of 2s. and 4s. respectively.

Traction descriptions are mainly remarkable for a sharp drop in City and South London stock, for which a small selling order was responsible, in a dull market. British Electric Traction keep steady with no particular feature. The new issue of Preference shares was subscribed several times over, but the market wants to know how the allotments were worked out, some people having apparently got 5 per cent. more than others. The premium on the new issue is about 15s. per share. The tramway traffics were irregular, but the increase of £749, reported by the Buenos Ayres and Belgrano, had a stimulating effect upon business in the shares, the price advancing to 5¼. Barcelonas have been done at 13⅛, and there is no move to report in Anglo-Argentine, which remain at 4. Blackpool and Fleetwood shares are 18, and there is a talk of a new system of electrical trams all over South Lancashire. Oldham, Ashton & Hyde's are quoted in the Manchester list:—Ordinary, 19—19½, and Preference, 10⅞—10⅞; and Kidderminster and District Preference are in the Birmingham list at 6—6½.

There are several new companies now before the public, and we must congratulate the promoters upon their bravery in attempting to launch fresh ventures at a time like the present. The market has taken very little interest in them. The American Government's proposal to lay a new cable to the Far East is not taken very seriously, and its effect upon the existing companies has scarcely been discussed.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Nov. 29th.	Closing Quotation, Dec. 6th.	Business done during week ended Dec. 6th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	..	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	66 — 69	65 — 68	66⅞	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	117 —118	115½—116½	117⅜	115½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	17½— 18	17 — 17½	17⅜	17¼
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15¼	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	198 —202	198 —202	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104⅛	104½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	½— ¼	½— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
80,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3¼%	11⅜— 12¼	11⅜— 12¼	12⅛	12
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	156 —161	154 —159	157½	154
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	98 —101	99½	99½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122	116 —121	118½	117½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15½— 16	15½— 15⅝	15 13/16	15½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	118 —123	117 —122	...	...
85,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	102¾	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	101 —104%	101—104%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	11½— 11¾	11½— 11¾	11½	11 7/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 16	15⅝	15½
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31 — 33	31 — 33	...	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	48	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5 — 5½	5 — 5½	5 1/16	5 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14½	14
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5⅝	5½— 5⅝	5 5/16	...
1,829,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	101¾	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	102 —105	103	102
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7⅞	...
3,381	Submarine Cables Trust	Cert.	...	...	...	128 —133	127 —132	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,783£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	115¾	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	101½	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1 — 1¼	⅞— 1¼xd	1 1/16	1
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10 — 10½	9½— 10 xd	9 11/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8 — 9	7½— 8½xd	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	106 —109	106 —109	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10	...
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	9½— 10½	9½— 10½	...	..
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	111 —113	111 —113	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12	11½— 12½	11⅜	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	127½	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10½— 11½	10½— 11½	11	10⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	111 — 114	111 —114	112½	111½
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	2⅞— 3⅛	2⅞— 3⅛	3	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6 — 6½	6 — 6½	6⅜	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14½— 15½	14 — 15	14⅜	14
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½	13½— 14½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
81,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	15½— 16½	15½— 16½	16⅛	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3½— 3¾	4½— 4¾	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14 — 15	14 — 15	14½	13⅞

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Nov. 29th.	Closing Quotation Dec. 6th.	Business done during week ended Dec. 6th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅞— 3¼	2⅞— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	16½— 17	16½— 17	17	16 13/16
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13 — 13¼	12¾— 13¼	13⅜	13
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½— 12½	11½— 12½	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2¼— 2½	2⅛— 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13 — 14	13 — 14	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	...	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅛	...
178,308	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅝— 5¼	4⅝— 5¼	5	4⅞
71,447	Do. do. Def. do.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	5⅜	...
630,000£	City and South London Railway	Stock	1 1/16 %	1⅛ %	2½ %	63 — 66	61 — 64	63	62½
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	4½	...	...	...	3½— 4½	3½— 4½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2¼	2 — 2¼	2 3/16	2 1/16
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3¼	2⅜— 3¼	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ½	⅜— ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	10 %	12 %	14 %	13 — 14	12½— 13½	...	...
15,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	7 %	5¼— 5⅜	5¼— 5⅜	5 9/16	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅜	21⅛
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8¾— 9	8¾— 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13¾	13¼— 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	36 — 40	36	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9 — 10	9 — 10 xd	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	5⅝	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	102½	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 5s.—7s.
Oldham, Ashton, and Hyde Electric, Ord., 19—19½.
Do. do. Pref., 10⅜—10⅞.
Smithfield Market Electric, 1—3.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7⅜. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref., 6—6½ xd.
*T. Parker, £10 (fully paid), 18¾.

Bank rate of discount 6 per cent. (November 30th, 1899).

MARKET QUOTATIONS, Wednesday, December 6th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£39	£39	..
a " " " .. per ton	£27	£27	..
a Bleaching powder .. .. per ton	£6 1	£6 10	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£25 10	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	3½d.	3½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b " Sheet, in ton lots .. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8¼d.	8¼d.	..
c " Tube (brazed) .. .. per lb.	10d.	10d.	..
" Wire, basis .. .. per lb.	8¾d.	8¾d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£85	£85	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£85	£85	..
g " Rod .. .. .. per ton	£85	£85	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	7/-	..
h India-rubber, Para fine .. per lb.	4/6½ to 4/7½	4/6½ to 4/7½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	68/4	69/1½	9½d. dec.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 10	£17 12 6	2s. 6d. dec.
g " Sheet .. .. per ton	£19	£18 16	4s. inc.
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£9 10	£9 10	..
d Mica (in original cases), small .. per lb.	2d. to 8d.	2d. to 8d.	..
d " " " medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/2¼	From 1/2¼	..
o Platinum .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/	10½d. to 1/1	..
i Steel, Magnet, ace'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£28	£28	..
g Tin, block .. .. per ton	£124 5	139 10	£5 5s. dec.
g " foil .. .. per lb.	1/7	1/6	1d. inc.
n " wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j " Best Flax, 6 lea. .. per lb.	5½.	5d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	8¾ l.	8¾ l.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£25	£26	£1 dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

APPLICATIONS TO PARLIAMENT FOR ELECTRICAL POWERS.

(*Concluded from page* 878.)

The following particulars are intended to supplement those which appeared in our last issue:—

(*a*) Electric Lighting.

Name of place or town.	Description of powers.	Authority promoting.
Barmouth	... ...	Urban District Council
Basingstoke	... ...	Council
Brecon	... ...	Corporation
Brierfield	... ...	Urban District Council
Clacton	... ...	Urban District Council
Cobham	Cobham, Stoke-d'Abernon, and Byfleet	Cobham Gas Company
Crowborough	Electric lighting of Rotherfield, Buxted and Mayfield parishes (Sussex)	Uckfield Rural District Council
Freshwater and Totland (I.W.)	Brightstone, Brook, Calbourne, Freshwater, Mottistone, Newtown, St. Nicholas-in-the-Castle, Shalfleet, Thorley, Totland, Yarmouth (I.W.)	Freshwater and Totland Electricity Supply Company
Llandilo	... ...	Urban District Council
Llanrwst	Electric lighting of Llanrwst and Trefriw	Llanrwst Electricity Supply Company
Long Eaton	... ...	Urban District Council
Ogmore Valley ...	... ...	Ogmore Valley Electric Light and Power Supply Company
Do.	Extension of 1892 license	Ogmore Valley Electric Light and Power Supply Company
Ormesby	... ...	Urban District Council
Ormskirk	... ...	Urban District Council
Oswestry	Purchase of undertaking of Oswestry Electric Lighting and Power Company, Limited; revocation of 1894 order, &c.	Council
Pwllheli	... ...	Corporation
Ramsgate	... ...	Isle of Thanet Electric Tramway and Lighting Company
Redcar	... ...	Urban District Council
Shildon and East Thickley	... ...	Urban District Council

(*b*) Electric Traction (Tramways, Railways, and Light Railways).

Ashton-under-Lyme ...	Construct and work tramways, electricity, 4-ft. 8½-in. gauge, junctions with the Oldham, Ashton, Hyde and District electric lines, and with Manchester Company's system	Corporation
Bootle	New tramways, electrical working, &c.	Corporation
Camborne and Redruth ...	Tramways, 3-ft. 6-in., electrical working, generating stations, and purchase of power from other companies	Urban Electric Supply Company
Cheltenham and District ...	Light railway extension	T. Nevins, of New Jersey, U.S.A., and 22, James Street, London
Cinque Ports	Light railways for connecting a number of towns and districts, electrical working. (See Electrical Review, page 887, December 1st, 1899.)	David Cook, promoter; J. T. Rossiter, engineer; and Mark Parker, resident engineer
County of Hertford ...	Light railways	County Council and Metropolitan Tramways and Omnibus Company
Dewsbury	New tramways, electrical working, &c.	Corporation
Garston	New tramways, electrical working, &c.	Garston District Tramways Company
Gloucester and District ...	Light railways, within the City and County of Gloucester, electrical powers	City of Gloucester Tramways Company
Gorton	New tramways, electrical working, &c.	Urban District Council
Hereford (County of) ...	Light railways	County Council and the Metropolitan Tramways and Omnibus Company
Hull	Construction and working of additional electric tramways and purchase of Drypool and Marfleet Steam Tramways	Corporation
Kearsley	Various tramway powers, new lines, electrical working agreement, &c.	Urban District Council
Llanelly and District ...	Light railways in the County of Carmarthen	Llanelly and District Electric Lighting and Traction Company
Mansfield and District ...	Light railways	J. Fell, J. Lewis, W. J. Kershaw, and others
Plymouth	Construction and working of additional electric tramways ...	Corporation
Radcliffe	Construction and working of electric tramways, 4-ft. 8½-in. ...	Urban District Council
St. Helens	New tramways, electrical working, &c.	Corporation
Southampton	Construction of new and reconstruction of old lines for electrical working	Corporation
Surbiton	New tramways, electrical working, &c.	Urban District Council
Taunton	Construct and work electric tramways and supply of current for power for public and private purposes	Corporation
Wakefield and District ...	Light railways	Company promoted by J. Fell, J. J. Gittings, E. Horton, W. J. Kershaw, and others
Warrington	Construction and working of electric tramways, 4-ft. 8½ in. ...	Corporation
West Hartlepool ...	Light railways extensions	Hartlepool Electric Tramways Company
Whitefield	New tramways, electrical working, &c.	Urban District Council
Wigan	Construction of 3-ft. 6-in. gauge tramways, and electrical working	Corporation
Wotton-under-Edge ...	Light railways in the County of Gloucester	Railway Developments, Limited

The Cork Electric (Blackrock extension) Trams, and the Shannon water and electric power scheme are also down in the list.

Other light railway orders are being applied for (but the motive power is not indicated) respecting East Sussex; Bridgwater, Stowey and Stogursey; New Romney and Hythe; Brackenhill; East and West Yorkshire Union Railways; Warrington and Northwich.

We read in the *Times* that November 30th was the final day for the deposit of plans and other documents at the Private Bill office in connection with local Bills in promotion for the ensuing session of Parliament. The number of plans deposited by November 30th last year for the session of 1899 was:—Railways, 60; tramways, 16; and miscellaneous (including water, gas, navigation, and County Council Bills), 98; general provisional orders, 77; and electric lighting provisional orders, 114; or a total of 365. The deposits this year for the session of 1900 were:—Railways, 50; tramways, 32; and miscellaneous, 97; general provisional orders, 133; and electric lighting provisional orders, 109; or a total of 421.

TESTS OF RAIL BONDS.

At the American Street Railway Association Exhibition in Chicago in October last some electrical tests of the Edison-Brown rail bonds were made in the presence of prominent railway men. Some particulars of the tests are furnished to us by Mr. Harold P. Brown, of New York, as follows:—

"Joint of 80-lb. tee rail unbonded, connected in series with a joint of 70-lb. tee rail having one Edison-Brown solid copper bond under each angle plate.

"With a current of 2,000 amperes through the 80-lb. joint the drop was ·423 volt. As a bond could not be put in the proper place and removed quickly enough for purposes of demonstration, contact spots were amalgamated on the top of each rail at inner ends. A No. 0000 solid copper bond was then laid upon these amalgamated spots so as to bridge the joint. The drop with 2,000 amperes was ·018 volt; the drop of 1 inch of this rail with the same current was ·00223 volt. The bond merely laid on top of the rail held in contact by nothing but its own weight, was equal in resistance to but 8¼ inches of rail.

"The drop on 70-lb. tee rail joint with 2,000 amperes through the joint and bonds was ·01946 volt.

"With an extra bond laid on top of this rail, the drop with same current was reduced to ·00762 volt. And with 2,000 amperes the drop in 1 inch of this rail was ·00286 volt; the resistance of the bond was therefore equal to that of 7 inches of rail. As there were no track tools at hand this joint was made up with a 14-inch monkey wrench, and was therefore not as tight as it should have been for service. However, the showing is simply beyond the reach of any other copper bond.

"Two of the leading types of copper bonds were sent in for test by one of the Chicago railways under the same conditions; both being the No. 0000 size and applied in the proper manner to the rails. The loss on one with 1,000 amperes was ·425 volt; and with 2,000 amperes ·75 volt. With the other bond the drop was ·22 and ·37 volt. In each case the bond became red hot in the short time required to make the test."

We are informed that Mr. C. E. Sergeant, general manager of the Boston Elevated Railroad, states that tests recently made on Edison-Brown bonds show exactly the same low drop as when put in during May and June, 1898.

"The same make of bond was put in on October 28th, 1896, between expansion joints of the Metropolitan West Side Elevated Railway in Chicago, and these showed a drop of ·0010 to ·0015 volt. When measured under the same conditions on October 24th, 1899, it is stated that the drop was ·0010 to ·00122 volt.

"These tests were made in presence of Mr. M. M. Scott, electrical engineer of the road."

Other tests have been made and are reported to us as follows:—

Test made in presence of officials of the Chicago-Edison Company, in manhole on Adams Street, near Adams Street station of Chicago-Edison Company, on Edison tube across joint contacts draw-filed and bolted, through extension strips. Temperature 18° C. October 22nd, 1899. Drop taken with Weston millivoltmeter reading ·00002 per degree. Average of 10 readings, ·005464 volt. Average current 1,800 amperes. Time 10.55 to 10.57 a.m.

Drop across same joint with contacts amalgamated and treated with Edison-Brown plastic alloy. Average of nine readings, ·00363 volt. Average current 1,740 amperes. Time 11.26 to 11.29 a.m.

Similar tests on tube No. 13 in Chicago-Edison Company's subway near Chicago River. Ordinary bolted contact. Average of seven readings, ·00462 volt. Average current 1,800 amperes. Time 3.06 to 3.08 p.m.

Same joint on tube No. 13 with contacts amalgamated and treated with Edison-Brown plastic alloy. Average of seven readings, ·00321 volt. Average current 1,730 amperes. Time 5.47 to 5.49 p.m.

Tests on next joint east of above joint in tube No. 13 in subway; ordinary bolted contact. Average of seven readings, ·00448 volt. Average current 1,800 amperes. Time 3.23 to 3.25 p.m.

Drop across same joints with contacts amalgamated and treated with Edison-Brown plastic alloy. Average of seven readings, ·00303 volt. Current 1,730 amperes. Time 5.47 to 5.50 p.m.

Drop on one extension strip of flexible laminated sheet copper connecting above conductors. Average of 16 readings, 00268 volt. Average current 2,000 amperes. Time 3.15 p.m.

Drop across hot switch in Edison Company's power house with current of 540 amperes, ·0176 volt.

Drop with same current after one-quarter of the contact surface was amalgamated and coated with Edison-Brown plastic alloy, ·00168 volt.

NEW ELECTRICAL WORKS AT PRESTON.

There are strong evidences that great effort is being made to enable the supply of home-manufactured electric traction plant and material to keep pace with the demand. It is in connection with this very laudable object that we hail with satisfaction the completion of a very important electrical works in the Preston district. These works derive much importance from the fact that they are claimed to be by far the largest in Great Britain devoted to the manufacture of electrical apparatus. We refer to the factories of the English Electrical Manufacturing Company, whose prospectus has this week been before the public. The works are equipped with machinery and tools necessary for the manufacture of electrical machinery—more particularly tramway and railway equipment apparatus—on a large scale.

One point of special interest in connection with the undertaking is the question of labour. It is interesting to learn that, although when the works are in full running the employés will number 3,500 men, there is no great difficulty anticipated in finding the labour required.

The experience of the kindred undertaking under the same auspices—the Electric Railway and Tramway Carriage Works, Limited—which, within six months, has reached its full output of 13 tramcars per week, and which for this employs some 500 men, goes to show that with airy, well lighted and comfortable shops, joined with fair treatment and liberal scales of payment, the British workman is capable, if he so incline, of meeting his American competitor both as to the quality of his work and ability to turn it out.

As part of the new Preston undertaking, there is now in hand the erection of some 250 workmen's cottages on an excellent site in the immediate neighbourhood of the works, and this number will rapidly be added to during the course of next year.

The works of the English Electrical Manufacturing Company will be in full operation by the end of next month (January, 1900). They will commence with the production of electrical traction equipment at the rate of 3,000 tramway motors, and 50,000 KW. capacity in generators per annum. The erection of the works has been carried on with noteworthy rapidity, for the first excavation for the foundations was made in June last; by December 31st of this year the buildings will all be completed, and the machinery throughout in place. It is hoped that delivery of finished motors and controllers will commence by March 1st next. If these hopes are fulfilled the whole undertaking, from laying the foundation stone to actual turning out of work, will have occupied only nine months.

The factories are situated in Strand Road, Preston, where 10½ acres of land has been secured from the Preston Corporation. In addition to electric traction equipments, the works will devote special attention to the manufacture of the larger units—both for alternating and direct currents—for electric lighting and transmission of power. The facilities provided in the shops will enable the company to build motors of any required size, electric locomotives up to 100 tons in weight, and generators with a capacity of 10,000 H P. each.

The equipments of the machine shops, foundry and power house, are, of course, of the most efficient and up-to-date character. All the machine tools and appliances are arranged to be driven, either individually or in groups, by electric motors ranging in capacity from 5 to 100 H P. The main line shafts will be driven by 10 slow-speed 50-H P. motors.

As to the present position of the order books, we are informed that already orders have been received through Messrs. Dick, Kerr & Co., Limited, for over 2,000 tramway motors to be manufactured during next year, as well as for a considerable number of generators. This fact, in itself, shows the room which exists for an undertaking of this character. Amongst these orders are numbered 400 motors for the Corporation of Liverpool, 200 motors for the British Electric Traction Company, and also orders for the motors required for the tramways of the Corporation of Sunderland, the Corporation of Dundee, the Corporation of Southport, the Corporation of East Ham, the Corporation of Leeds, the Grimsby and Cleethorpes tramways, &c.

An order of particular significance which the works have received through Messrs. Dick, Kerr & Co., Limited, is one from France for 800 motors for general distribution throughout the Continent of Europe. This is the first occasion on which so important an order for electric traction apparatus has been placed with any British manufacturer, and we have no doubt that the Preston works will play an important part amongst the great electrical manufacturing concerns of the world.

The works have the advantage of the knowledge and long experience of Prof. Sidney H. Short, whose reputation in the States is well known to readers of the Electrical Review.

That the undertaking will be run on a combination of the most modern American and English methods and practice goes without saying, and we wish the English Electrical Manufacturing Company a successful career.

LONDON COUNTY COUNCIL AND ELECTRIC LIGHTING LOANS.

At last week's meeting the Council decided to sanction the borrowing by the Islington Vestry of £7,689 to defray the cost of providing street arc lamps and lamp columns.

Dispute as to Lighting Loans.

The Finance Committee reported that the Islington Vestry had applied for sanction to borrow £13,200 for the provision of additional plant at the Eden Grove station. The information supplied with the application, and on a subsequent occasion, was not sufficiently detailed to enable the Committee to judge whether the cost was fair and reasonable, and they had therefore directed the Comptroller to apply for further details. To this request the Vestry replied through their clerk that they had given every particular which could reasonably be asked for and added:—

That the estimates have been prepared by the Vestry's electrical engineer, and approved by its Electric Lighting Committee, and that my Vestry having perfect confidence in the judgment of both deems it inconsistent with its position as electric lighting undertakers for the parish, to recognise the claim of the Council's officials to be supplied with the details in question.

It was further stated by the Finance Committee that the Islington Vestry had for some time past been questioning the right of the Council to satisfy itself, before sanctioning the borrowing of money by local authorities, as to the legality and reasonableness of the proposed expenditure. The Council, following the practice of the late Metropolitan Board of Works, had always held the opinion that it was its duty, as the sanctioning authority, to consider those points, and that practice, which had never been questioned by the other local authorities in London, was in conformity with that of the Local Government Board when dealing with applications from other local authorities throughout the kingdom for sanction to the raising of loans. In view of the opinion expressed in the letter from the vestry referred to above, and of the practical refusal to supply the

details asked for, the Committee recommended the Council to inform the Islington Vestry that until the particulars required were supplied, the Council would be unable to arrive at a decision upon the application to borrow £13,200. Mr. A. M. Torrance asked the chairman of the Committee to take back the recommendation for further consideration. Dr. Napier said that the question at issue was a matter of principle which the Council should not pass over without serious consideration. It was the duty of the Council to sanction a number of loans, probably nine-tenths of the loans required by the local authorities in London, and they must be satisfied that the manner in which the money was to be expended was economical and for the districts concerned. The Council's engineer had advised the Committee that the method proposed by the Islington Vestry was not fully explained, and the Committee had only adopted the usual course. It was, however, contended by the Vestry that if the Council was satisfied that the former had power to borrow the money it ought to give its sanction, that it ought not to fix the rate of interest or the period of repayment, and that it ought not to institute an inquiry as to whether the Vestry was spending its money economically. Next year there would be a right of appeal of the local authorities to the Local Government Board in cases where the Council refused to sanction loans, and the Board might then make rules dealing with the question. The speaker proposed, therefore, that the recommendation should be referred back to the Committee so that the subject might receive further consideration. Mr. T. B. Williams, in seconding the amendment, submitted that the Council should be fully informed of the points of difference between the Finance Committee and the Vestry. There was no information in the report to serve as a guide to the members, and he thought some details should be presented to the Council before an expression of opinion on the matter was given. Mr. Howell J. Williams suggested that as the chairman of the Finance Committee had expressed his readiness to take back the report, the mover of the amendment should withdraw his proposal. The Islington Vestry desired to have a friendly conference with the Committee in regard to the matter.

Mr. W. W. Beuch, chairman of the Finance Committee stated that he was prepared to withdraw the report for the purpose of having a conference with the Islington Authority on the subject, and the Council decided to allow this course to be adopted.

Electric Lighting of Asylums.

The adjourned report of the Asylums Committee, to which reference has been made in our columns, recommended the Council to approve the principle of the provision of a central station for the supply of the electric light and water to the asylums to be built on the Horton Estate, and that the Committee should be authorised to bring up a scheme for the approval of the Council. Colonel Ford, as an amendment, proposed that the recommendation should be referred back to the Committee pending the issue of the report in regard to additional asylum accommodation. He said that the Council was being asked to vote in the dark, there being no estimates submitted by the Committee. Mr. M. Beachcroft, in seconding the amendment, contended that the proposal of the Committee was premature since they did not know where the principle would lead them. Mr. N. W. Hubbard, chairman of the Asylums Committee, read a letter from Mr. Clifford Smith stating that the cost of buildings and plant for a central station for the supply of electricity would amount to £42,000, and that that sum would include certain provisions for future extensions. As a matter of economy it would be wise for the Council to give the Committee authority at any rate to prepare a scheme for submission to the Council.

The amendment having been rejected by a large majority, Mr. W. Bauch, as a further amendment proposed that the Asylums Committee should be authorised to bring up a scheme for the erection of a central station, together with an estimate of the cost. That would not, he contended, pledge the Council to the approval of the principle of the scheme. Mr. D. S. Waterlow formally seconded the amendment which was agreed to.

HEAT ABSORPTIVE POWER OF WATER.

Hardly sufficient notice has, we think, been accorded to a recent paper by Mr. C. Holliday before the Institute of Marine Engineers. Mr. Holliday dealt with the absorption of heat by water in tubes especially with reference to differences of temperature and differences of velocity. We may take it to be generally true that more heat will be absorbed when the difference of temperature is greater, and it does not require much reasoning to arrive at a prompt solution of the problem as regards velocity. When water flows through a pipe, the molecules next the pipe are retarded by the roughness of the surfaces over which they pass, and we may take it for granted that the water column has its exterior put into a state of movement. The skin of the water column is held back, and the interior of the column in turn presented to the pipe. A solid India-rubber ring, rolled along a stick—an umbrella ring, for example, may be taken as illustrative of the action that occurs all along the length of a column of water moving in a pipe. Now, if the velocity of such column be made great, the ring will revolve more frequently, and will serve to maintain the inner surface of the pipe at a lower temperature by more rapidly transferring the heat from the pipe to the interior of the water column. The rolling rings are, in fact, alternately receiving heat at their outer circumference and parting with it at their inner circumference. This inner circumference in its turn is acting by friction upon the next layer of water, and in this way we may assume that a moving column of water consists of a numberless series of ring columns one inside another all in a condition of vortical rotation and transferring heat from without to the centre of the column. Obviously if a column move slowly its outer rings will be more heated, and there will be less difference of temperature to transfer and the heating efficiency will be reduced. Mr. Holliday's experiments bear out this reasoning. By quadrupling the flow though a pipe from 5 to 20·7 cubic centimetres per minute, the difference of temperature of the ingoing and outgoing water remained nearly the same. This means, of course, that the thermal units absorbed from a source of heat of the same capacity in each case were nearly fourfold in the latter case. In a second series of experiments ranging from 9·2 to 84·5 cubic cm. per minute the heat supplied was varied, and the results are not very comparable, but in a third set with constant capacity of gas heater and a flow varying from 7·2 to 150 cubic cm., the heat absorption varied from 1,095 to 2,460 thermal units per minute, the difference of temperature of the in and outgoing water varying from 152·1 to 16·4.

Other tests proved a point of maximum absorption of heat. With a flow varying from 24 to 210 cb. cm., the heat absorption varied from 3,648 to 4,998, and the difference of temperature from 152 to 23·8, but there were intermediate rates of flow, namely, 118 and 160 cb. cm. per minute, which gave heat absorption of 5,123·5 and 5,120 thermal units. At both lower and higher speeds the heat absorption is less. All these tests were with comparatively cool water. It was next attempted to show effects when the flowing stream was near ebullition point, so as to prove if the absorption of heat by such water is the result of more rapid movement of the water over the surface, or of some change in the quality or nature of the water, causing it to take up heat more readily. For this purpose straight tubes were used in place of spirals, as heretofore, and longer jackets were employed, so as to give the necessary area of exposure to heat.

With an outflow of 17·5 cb. cm. per minute at 211° and 212°, the inflow was 55°, and the difference 155·4°, showing an absorption of 1,787 units per minute. Increasing the flow to 30 cb. cm., with 195° to 200° outflow and 50° inflow temperature, or 143·5 average difference, the heat absorption was 4,314, as against the 1,787 when the water was near the boiling point. This appears to disprove any idea of a different physical characteristic of the water, and leaves the difference to the credit of the more rapid movement. Further tests under the same conditions of large capacity of source of heat gave results, with flows varied from 36·5 to 205 cb. cm., which varied from 4,684 units, through a maximum of 5,458·6 down again to a final 2,747, the maximum occurring at a flow rate of 106·2, and the final maximum of 2,747 occurring at 205 cb. cm. of flow. This last, occurring as it does after the 4,585 units shown for a flow of 175 cb. cm., is very remarkable. Equality of heat absorption is the notable fact from 77·5 to 135 cb. cm. rates of flow.

Evidently, so far as these tests show, there is a maximum heat absorption at or near a flow of 100 c.c. per minute.

It is not wise to found too much on this figure, for it must have a certain relation to the tube diameter and to the linear velocity, but it is interesting as fixing a point for the same conditions as to tube diameter and velocity of flow. Mr. Holliday finds that when steam is formed the results are reduced, more heat being absorbed by a flow of 26·43 c.c. per minute ejected at 209° from an inflow at 53° than was secured with a flow of 19·4 c.c. ejected at 212° with inlet at 51°. The heat units were 3,113·7 when steam was formed, and 3,933·6 when the boiling point was not reached—a difference of 819·9 units, which can only be accounted for by the reduced absorption due to the steam and by the increase of velocity. A still further increase of the flow in this last case gave *cæteris paribus*, a maximum heat absorption of 6,344 units, with 158·6 c.c. of flow, with a rapid drop to 3,286·1 units, when the flow was increased still more to 193·3. Maximum heat absorption, in the conditions of the test, seems to centre about a temperature difference of the in and outgoing water of 40 to 50° F.

It should be noted, however, that the falling off in the heat absorption after the critical point of maximum is ascribed by Mr. Holliday to the insufficient supply of heat to meet the demands of the rapidly moving water. Possibly, therefore, with a larger source of heat the thermal absorption would continue to increase with velocity. In diagrammatic form the sudden drop of the heat unit curve of absorption is so sudden as to lend support to Mr. Holliday's explanation, though the rising curve rather points to another conclusion, for the curve of rise of effect is hardly less steep than the curve of final drop. Taking the whole into general review, it would appear probable that there are velocities suitable to each size of tube, and it is to be hoped that experiments may be made on practical tubes of different sizes and materials.

Mr. Holliday's conclusions are that the absorption of heat is a function of the velocity of flow and the quantity of heat present in the heat source, that absorption increases with the velocity of the water up to a certain point which depends on the source of heat, a Bunsen flame or steam jacket; that heat absorption falls off after a certain velocity, which also depends on the source of heat and may depend on the kind of motion the water has within the tube. He asks very pertinently, "Does the water move rigidly at these velocities, and therefore fall in absorptive power because there is not time for the heat to be conducted to the inner layers of the moving column?" This brings us back to the idea of the vortex rings with which we prefaced this article. It is probable that if this suggested rigidity of flow really occurs, its formation would be delayed by the use of spiral retarders of flat strip, with a long pitch of revolution. Such retarders, so called, would serve to disrupt the inner mass of the moving columns of water and give a spiral rotation, which might counteract the rigidity or its effects. The subject is one which is of great interest, and is specially so to those interested in water-tube boilers of the small tube variety.

ELECTRICITY ON WARSHIPS.

Writing in the *Engineering Magazine* Lieut. J. K. Robison deplores the wastefulness of electrical engines on board ship as compared with engines ashore.

It was naturally supposed that the economies of central station practice ashore could have been repeated afloat, but this has not proved to be the case, and the steam consumption per unit is anything from 55 to 100 lbs. per I H P.-hour. Later engines of better type are, it is hoped, going to run for 30 lbs., but even this is too much, and better engines ought certainly to be produced, an end to be attained, in the author's mind, in part when flat valves are used on low pressure cylinders, and leakage is thereby much reduced. In the United States Navy 50-KW. sets are a maximum, and our author thinks if connected with the main condenser that they will run for as little as 20 lbs. per I H.P.-hour, or 26 lbs. if the exhaust be carried to a feed heater. When run non-condensing he estimates that 30 per cent. will be added to the steam consumption. Something like 9 per cent. of the total coal may be saved by exhaust feed heating. Hence, if 30 per cent. of the auxiliary plant steam exceeds 9 per cent. of the total steam consumption it will pay to run condensing on the auxiliaries, as to which, however, we would add that this supposes cold feed, and that feed heating by waste gases on shipboard appears to attract very little attention from marine engineers, probably because of the complication it is supposed, we think erroneously, to bring about.

Much depends on the total efficiency of conversion between the generating engine and the motor shaft. Prof. Thompson gives figures showing 52 per cent. average under fairly good conditions. Naval experience has pointed to 50 per cent., and the experience of large commercial users of electricity shows from 40 to 50 per cent. Mr. S. Dana Greene has stated recently that it may be 60 to 65 per cent. The author considers it fair to assume 59 per cent., namely: engine, 86; generator, 93; line, 95; motor, 78. This assumes commutators in good condition all round. These efficiencies do not appear to be startling. They ought to be secured. In the United States Navy commutators are not in order, but would be kept so if electricity were largely installed. Beyond the motor the efficiency is assumed the same for both electrical and steam driving, an assumption obviously unfair to electricity in some cases, as for example, fans which can be driven by an electrical motor direct in a much more efficient manner than by a steam engine. But in other cases, as in a steam pump or an ice machine, the steam engine has the advantage over a geared motor. Taken all round, therefore, 59 per cent. is claimed to be a fair figure. Roughly, it will require 5 H.P. in the generator engine for 3 H.P. in the motor shaft. Steam at 26 lbs. per H P.-hour implies, therefore, about 44 lbs. of steam in auxiliary engines.

This, then, is the figure with which for reasons of economy it is necessary to compete, and this is 35 per cent. less than the amount of steam used by most modern steam auxiliaries. If auxiliaries now use 18 per cent. of total steam, they will in electrical work only use 12 per cent. All the gain of the electrical system is estimated to be clear saving down to 15 per cent. which means that each pound of coal on a warship is potentially increased 3 per cent., and the steam consumption of electrical auxiliaries is now reduced to such a figure that practically all the exhaust can be swallowed up in the feed heater. At any rate, 40 per cent. of the difference between 12 and 15 per cent. will be a saving owing to the fact that more steam is used in the evaporating plant if the pressure is reduced to that of the auxiliary exhaust.

The net saving due to electricity is thus 4·2 to 6 per cent. when generating engines do not exceed 26 lbs. per I H P.-hour. But other considerations demand attention. These are connected with the weight of auxiliary machinery. In a full-sized battleship the auxiliaries have about 1,500 H P. and weigh 150,000 lbs. or 100 lbs. per H P. With electric motors torque must be obtained by having motors at least 50 per cent. above the steam rating. This involves about 2,250 H P. of motors, for ship motors are usually small. The increase of weight will be 35 tons. Of the total of 1,500 H P. only a part will be run in action, say, 700 H P., many articles such as deck winches being cut of use. With electricity probably 1,000 H P. would be in use in action, or 1,600 at the generating engines. This implies five 250-KW. generators, counting one as spare. This 1,250 KW. of plant will weigh 180 tons, so that the total electrical plant will weigh 295 tons as against 85 tons with steam operation, or 3½ times as much. Mr. Dana Greene gives the more optimistic figure of 2½ to 3 times as much weight. Our author thinks 4 times will be much nearer than 2½. Even at the optimist's figures an additional weight of 150 tons must be carried, an increase considerably greater than 6 per cent. of the 2,000 tons bunker capacity of the largest ships. Hence, to add 6 per cent. to the potential of the coal, we must reduce its weight by 10 per cent. and shorten the radius of action of the ship. Now, this is a very serious factor, and it is more serious in the British Navy than in any other in some respects, for though we may possess many coaling stations it is wise not to depend too seriously on every one of these, and a battleship out of coal is in a very serious plight indeed.

Our author proceeds to show the value of coal endurance by citing U.S. *Newark*, disabled 300 miles north of the Straits of Magellan for lack of coal to complete 2,500 miles of a voyage between Monte Video and Valparaiso. Nor should the *Rio de Janeiro* be forgotten, which had to turn back on the voyage between Honolulu and Yokohama, a matter of only 3,500 miles, and only succeeded in reaching her port of departure by using her cabin fittings as fuel.

The Russian ships built by Cramps are the most modern examples of electrical fitting for auxiliary plant, and it will be of interest to watch their performance. The principal advance foreshadowed by Lieut. Robison is an efficient turbine engine able to maintain high efficiency over a wide range of power. This will save steam and reduce the weight of a generating set by some 40 or 50 per cent. A better efficiency of conversion overall may also be anticipated in the future, especially in the case of motors. With these improved conditions, possibly 100 tons increased weight would serve, and the effect on coal endurance being lessened, there would be so much convenience attaching to electrical operation as to render its adoption probable. At present, we believe, in our own Navy, hydraulic power holds the field; steam is so easily cooled and condensed that auxiliaries distant from the boiler must always be most wasteful. Even the wastefulness of compressed air is not so great but that compressed air appears to be a very formidable rival to steam.

The author, in conclusion, points out that steam engines may be much improved, more especially in the line of feed heating from intermediate receivers. To-day, electricity asks in its usage more than it can return. Hence it is premature to force its use on board ship, and more especially on ships of war. Obviously the floating station has wide differences of conditions from a station ashore, and what may be an easy economy in one case is in another converted into a loss. Lieut. Robison's article takes a very broad and impartial view of the whole question; while not too optimistic, it is hopeful.

NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

METHODS OF SUPPRESSING ARCS IN SWITCHES, FUSES, &c.

By Ernest Kilburn Scott, A.M.I.C.E.

(*Read at Manchester, Tuesday, December 5th.*)

Part I.—Switches.

When two terminals through which current is flowing are drawn apart, the area of contact becomes gradually less and less until just before connection is actually broken, the area is so small that the metal vaporises. This vapour is equivalent to inserting a resistance between the terminals, and if there is a well-sustained voltage, then current is forced across, and the $C^2 R$ loss appearing as heat in a very confined space, we get an arc which, unless suppressed in some way, will continue to feed itself by vaporising still more metal.

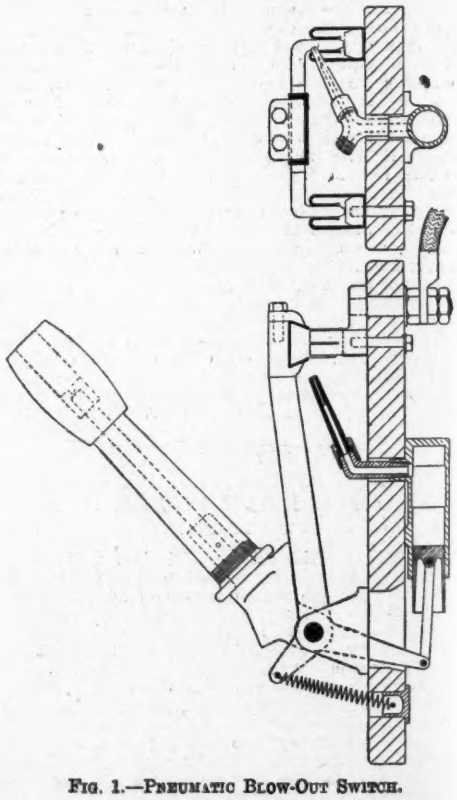


Fig. 1.—Pneumatic Blow-Out Switch.

Except under very special circumstances, to be mentioned later, we cannot *prevent* an arc forming. We can, however, *suppress* it after it has formed, and the writer proposes to discuss some of the devices which have been devised from time to time with this object.

Quick Break.—At a very early stage in electrical work it was found that, by separating two contacts at a very *rapid* rate, the path of vaporised metal increased so quickly that the current was unable to maintain its value and the arc broke down.

Material of Contact.—Another point soon noticed was that the higher the melting point of the metal the less the arcing, due to the fact that less conducting vapour was set free in a given time. An absolutely infusible metal, if such were possible, would not arc, neither would a metal having zero resistance; it follows, therefore, that switch contacts should have as low a resistance and as high a melting point as possible; the low resistance of copper and the high fusing point of platinum, for example, as is arranged in Berend's switches, which have copper contacts fitted with platinum tips to take the arc. Carbon is one of the most refractory of conducting substances which electrical engineers use, but, unfortunately, owing to its granular formation, a good contact cannot be depended on, and

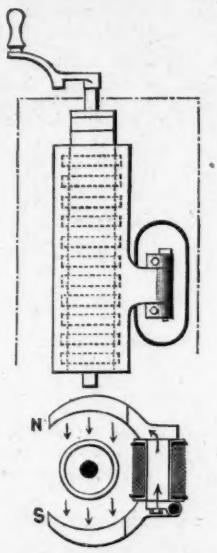


Fig. 2.—Magnet Blow-Out Controller.

even if it could, the resistance would in most cases be too great for practical work. The best that can be done, therefore, is to employ it as a subsidiary contact block by arranging the carbon in multiple with the main switch in such a way that the main contacts are opened first, current being thus shunted through the carbons, which act as a resistance, and at the final break receive the full effect of the arc.

Multiplication of Breaking Points.—Other things being equal, the arcing which takes place between two sharp points is much less than that between flat surfaces. It is also found that breaking a given current at a number of points does not volatilise nearly so much metal as if all the arcing occurred at one point. This being probably due to the cooling effect of the larger volume of metal necessitated where there are a number of breaking points. Once an arc is fairly established there would be, of course, no cooling effect worth mentioning however large the surface.

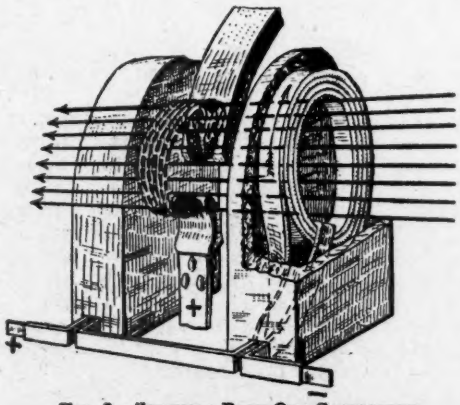


Fig. 3.—Solenoid Blow-Out Controller

There is a limit at which a quick break, multiplication of contacts, the employment of carbon, &c., gives satisfaction, and with the increasing employment of high voltage and large powers much ingenuity has been called into play.

Pneumatic Blow-out.—As the arc is primarily the result of a stratum of metallic vapour reaching from one piece of metal to another, it follows that a simple way to stop arcing would be to dissipate the conducting vapour in some way, and an effective method of doing this is to blow out the arc. This idea was first introduced on the Thomson-Houston arc lighting machines, each machine being fitted with a small blower capable of giving two jets of air at about 10 lbs. pressure. (In some of the larger American stations an air pump and reservoir is laid down, capable of supplying several machines.)

The bare idea of applying a pneumatic blow-out to a switch has been suggested many times, but although such an excellent arrangement, it is only within the last year or so that it has had practical application, it being now used for switches for long distance transmission of power work in America. The writer got out designs for a high tension switch, fitted with air blow-out, as early as 1895, and fig. 1 shows such a switch for 2,200 volts, 75 amperes, fitted with loose handle and spring quick break. In being pulled into the off position air is forced from the cylinder at back of marble slab, and is directed against the contacts by means of two fibre nozzles.*

To Stop Arcing by Partial Vacuum.—At the central station of the Burgdorf-Thun, three-phase electric railway at Spiez, the switch contacts are so arranged that, when drawn apart, a partial vacuum is set up, which has the effect of shutting down the arc. The arrangement is very simple, the switch contact being driven into an ebonite tube, into which it fits fairly closely, and at the bottom of which there is the other contact.

Magnetic Blow-out.—It was thought at one time that the *magnetic blow-out device* of Prof. Elihu Thomson had solved the trouble of arcing at switch contacts, but experience has shown that it has its limitations.† As is well known, it was originally designed for lightning arresters; it was then brought into use for circuit breakers on tramway switchboards, but its principal application has been on series parallel controllers for tramcars.

The arrangement of a controller blow-out is shown diagrammatically in fig. 2. It will be seen that the North and South poles of the magnet are so arranged, that lines of force stream right across the cylinder contacts, and as this distance is about 9 inches, a good deal of energy is required to produce a strong magnetic field between

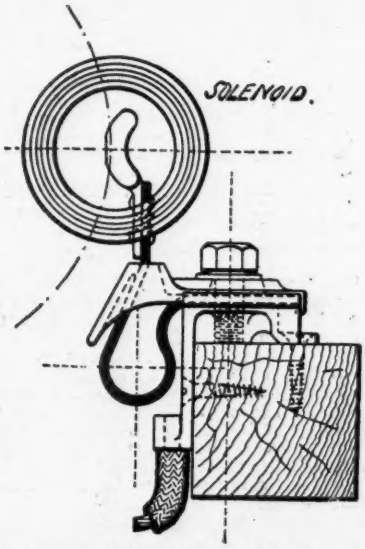


Fig. 4.—Contact of Solenoid Blow-Out Controller.

them. Whilst the car is in use, the magnet coil must always be kept in the main circuit of the trolley wire, because if it were only cut in just before the motorman moved his controller handle, the pole pieces would not be magnetised in time to blow out the arc formed between the segment and contact finger. There would also probably be further trouble, due to self-induction. It will thus be seen that keeping the magnet continuously excited is a serious drawback, on account of energy being used up all the time. A further obvious objection is that owing to the confined space, the area of the magnet iron is limited, and thus, although the blow-out works satisfactorily up to the point when the magnet becomes magnetically saturated, for any extra large currents which have to be taken, the magnetic field is not strengthened in proportion, and the blow-out thus falls short just at the very time that effective operation is most sorely needed.

Solenoid Blow-out.—These drawbacks led Mr. S. H. Short to intro-

* Simply striking at arc with a mop of cocoa-nut fibre, or other material that will not easily catch fire, is very effective. At Deptford arcs of 3,000 H.P. and 10,000 volts have been repeatedly broken in this way.

It may be noted that the main switches used on the Brooklyn electric lighting system are fitted with an electrically controlled pneumatic attachment, but the actual break is made under oil. It is therefore not a blow-out switch, but one in which compressed air is used for actually operating the switch. A similar arrangement is used at Niagara, and on the Pennsylvania Railroad.

† It is interesting to note that Mr. J. D. F. Andrews, as early as the year 1887, carried out experiments in which this magnetic blow-out idea was used. He was endeavouring to produce a satisfactory alternating current rectifier, and to overcome the sparking, used laminated iron brushes, magnetised by means of coils wound upon them.

duce what is known as the "*solenoid blow-out controller*," in which the electric magnet is replaced by a number of small solenoids (one to each contact). Each solenoid consists of a spiral of copper ribbon insulated with asbestos, forming a disc about 3 inches in diameter, and $\frac{3}{8}$ths of an inch in thickness, with a hole in the centre $1\frac{1}{4}$ inches in diameter. This spiral is embedded in a vulcabeston partition placed between the contact fingers of the controller. The two ends of the copper ribbon are brought through the edge of the vulcabeston partition, as shown in fig. 3, and are connected with the adjacent solenoids throughout the entire length of the finger board. The opening in the centre of the spiral comes just opposite the contact of the finger with the cylinder, and it is through this that the blowing-out effect is produced. The main trolley current passes through these solenoids for an instant only when an arc is to be broken, this being accomplished by a contact finger and its corresponding controller segment shunting the current through the solenoids at every running notch of the controller. Fig. 4 shows a detail of the finger contact in relation to the solenoid.

The advantages of the arrangement are:—

1. There are no metallic pole pieces in close proximity to the points where the arc is formed, and consequently less danger of the current being grounded. The contact fingers and segments of the cylinders are also quite free and open for inspection and repair.

2. As the solenoid does not get saturated, the blow-out effect increases in direct proportion to the current whose arc is to be destroyed.

3. The magnet blow-out drives the arc in a direction parallel to the axis of the controller cylinder, and thus causes the flame to impinge against the vulcabeston partitions, burning holes, and sometimes forcing the arc round to the next contact finger. With the solenoid blow-out the arc is driven directly away from the cylinder in a direction at right angles to its axis, and the insulating partitions are therefore never swept by the arc, nor is it possible for the arc to jump to the next segment, as the solenoid effect is produced between each of them individually.

4. There is no magnet to excite, and the action is therefore instantaneous, whilst there is very little waste of energy as the solenoid is only in circuit at the instant of the formation of the arc.

5. The magnet blow-out depends solely for its action on the magnetic field, and this has the effect of cutting the arc instantly in two (made manifest by the sharp report produced). Excessive self-induction in the windings of the motors is the result, and the insulation of the armatures and field magnets is thus very liable to be punctured. The solenoid, on the other hand, appears to have the property of easing down the current quietly, something like the effect of a fuse.

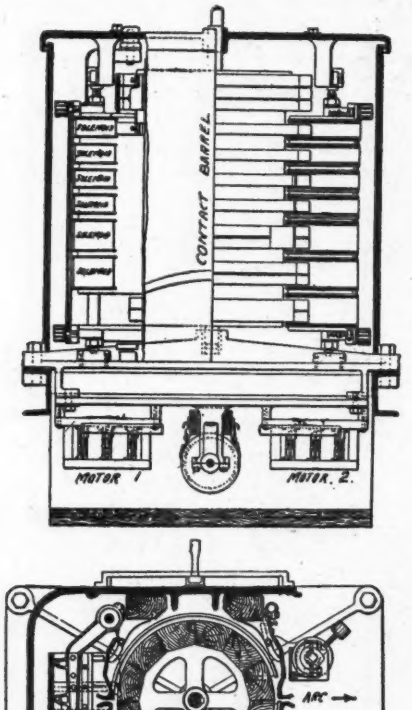


Fig. 5.—Solenoid Blow-out Controller as used on Central London Railway.

Fig. 5 shows the controller fitted with solenoid blow-outs, as used on the Central London Railway.

Hopkinson & Wood, Magnetic Blow-out.—Fig. 6 shows the magnetic blow-out as applied to a point contact switch by Messrs. Mather and Platt. A is the laminated contact brush and D is an iron cover, the magnetic circuit being D, F, M, F, and G. A similar arrangement to this was fitted on the controllers of the Hartlepool electric tramcars by the Electric Construction Company, Limited.

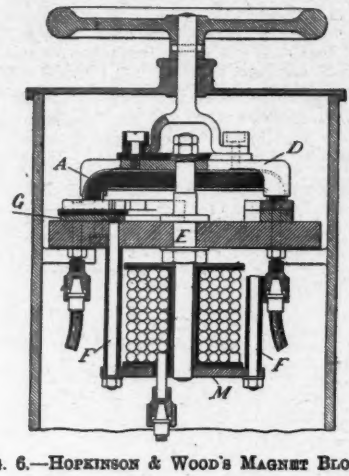


Fig. 6.—Hopkinson & Wood's Magnet Blow-Out.

(*To be continued.*)

COST OF CENTRAL STATION PLANT.

(*Concluded from page* 867.)

Testing Instruments.—About £135 will cover the following instruments:—One portable testing set consisting of an ohmmeter reading up to 10 megohms, and a magnetic generator giving 200 volts; one small dial bridge with spare plug fitted with cylindrical ebonite handle and flexible lead for potentiometer test; one Kelvin electrostatic multicellular voltmeter reading up to 500 volts; one Siemens dynamometer to read up to 50 amperes; one resistance frame for meter testing with eight-way switch to vary the current from 5 amperes to 50 amperes at 200 volts; two standard Carhart-Clark cells with thermometer; two detector galvanometers; 100 dry cells; 100 yards of No. 20 S.W.G. wire insulated with pure and vulcanised rubber for connections. Whilst £240 will cover the above and the following additional apparatus:—One testing table complete with tray, bridge, resistance, galvanometer, lamp stand, shunts, carbon megohm, reversing key, battery switch, &c.; one Kelvin standard current balance.

Accumulators.—We now come to the battery, which is such an essential feature of the continuous current station. In deciding on the output it is usual to assume that the station is going to be worked by only two shifts and arrange for a battery to take on the lighting from midnight until eight the next morning. As the lighting system extends there will come a time when three shifts of men have to be employed or else the battery very considerably extended, but if there is a considerable amount of street lighting then three shifts are required almost immediately. Perhaps the best way to rate the first battery is to allow $2\frac{1}{2}$ ampere-hours per kilowatt of generating plant laid down, thus for 9,000 lamps fixed three 90-KW. steam dynamos are laid down and this gives

$$2\cdot5 \times 3 \times 90 = 680 \text{ total ampere-hours,}$$

that is to say, the battery should be capable of giving 85 amperes for eight hours, *i.e.*, from 12 midnight until eight the next morning.

The battery room should preferably be on the ground floor on account of the convenience in getting the cells and acid in and out, and the regulating cells should be arranged as near to the switchboard as possible because of the great expense of the connecting cables; these carry the full current

from the battery and a foot or two makes a good deal of difference. In a battery, costing, say, £1,000, as much as £50 will be required for the connecting cables if connected up in the ordinary way, or £25 if connected to a Heath & Field patent regulator.* They are generally included in the switchboard specification, but in the writer's opinion, this heavy cable should be quoted for at so much a yard, the actual amount to be measured off when the switchboard and battery have been erected. One thing which has struck the writer as being essential in running a central station in which accumulators play an important part, is that at least one of the staff should have had intimate experience either in their manufacture or repair. Generally speaking, there are men in a central station who know all about engines, dynamos and switchboards, but nothing worth speaking of, about accumulators. Certain information is picked up after a while, but generally by that time the cells are well on the road to ruin unless there is a maintenance clause.

Workshop Tools, Oil Filter, &c.—A set of workshop tools to cost, say, £30, would consist of :—

Ratchet lever and drilling pillar with set of drills;
Two 6-inch parallel vices, one fixed to movable stand and the other fixed to a bench;
Two dozen assorted files;
Half-dozen assorted chisels;
Three engineers' hand hammers;
One striking hammer;
One lead hammer;
Three large screwdrivers;
One pipe wrench.

(Note.—A much fuller list must be allowed for abroad, and an 8-inch lathe and power drill should be included.)

An efficient filter and ample sized tank are very desirable as the yearly item for oil is a considerable one in central station work.

Station and Office Lighting.—This calls for no remark except to say that for advertisement sake the lighting should be carried out exceedingly well, and carrying out the wiring on various systems is useful for the purpose of showing prospective customers how the work may be done. An installation costing, say, £100, would consist of :—

Boiler house	 9	16 c.p.	
Engine room	 3	100-c.p.	
	 4	32-c.p.	
Pump room	 2	16 c.p.	
Switchboard	 4	16 c.p.	
Engineer's office	... 3	16-c.p.	
Test room	... 4	16-c.p.	
General office	 5	16-c.p.	
Battery room	 4	16-c.p.	
Main entrance	1	10-amp arc lamp.	
Back entrance and yard	1	10-amp. arc lamp.	
Men's lavatory	... 2	8 c.p.	
Office lavatory	... 2	8-c.p.	

Condensing Apparatus.—We have now gone through the various items in the table, and there remains for consideration the question of the condensing apparatus, which presents a distinct problem of its own. Generally the engines are specified to work condensing or non-condensing, and a condensing plant is added after the station has been running for some time and the engines are beginning to be comfortably loaded. Where large quantities of fresh cold water are available then the ordinary type of surface condenser may as well be used and 13½ lbs. of vacuum obtained. It is well to remember, however, that unless the air pump is of the very best the vacuum may drop after working for a short time to about 11 lbs., which is a figure commonly obtainable with an ejector condenser. The absolute necessity of having a thoroughly efficient air pump is now being recognised, and the Edwards' patent air pump is an attempt to place it above suspicion. Many stations have been fitted with the ejector type of condenser because of its cheapness, and the small amount of space occupied. If kept in order it can be depended on to give a constant vacuum of, say, 11 lbs. per square inch. The price of an ordinary surface condenser is about £1·5 per kw. of plant installed, which is about 4½ times the price of the ejector type; the space occupied is in a still greater ratio.

Obviously, to put in a cheap condenser which only gives on the average the same vacuum that can be obtained from an ejector condenser is waste of money.

* Messrs. Erlacher & Bosso, of Winterthur, Switzerland, have a similar switch, having for its object the lessening of the number of cables to the regulating cells.

Water Softener.—The question as to whether a water softener is required or not depends, of course, on the average quality of water throughout the year. An apparatus large enough to deal with the water for two Lancashire boilers, each 30 feet by 8 diameter, will cost about £200.

Total Cost.

It will be noticed from the Table that £47 per kw. of plant is about the average for 12,000 8-c.p. lamps fixed. To get at the total cost there must be added (1st) The cost of supplying and laying the feeders and distributors and house connections, which together average roughly 20 per cent. of the first cost of generating plant. (2nd) The cost of the site, which is naturally a very variable figure, but may be taken at 5 per cent. (3rd) The legal and other preliminary expenses, another 5 per cent. (4th) 2 per cent. to cover stores, &c.

From this we get :—

Cost per kw. of generating plant installed	£47
Add 20 per cent. of £47, to cover cables, &c.	9½
Add 5 per cent. of £47, to cover cost of site	2½
Add 5 per cent. of £47, to cover legal and preliminary expenses	2½
Add 2 per cent. of £47 to cover stores, &c.	1
	£62

A total of £62 per kw. of plant installed, which agrees fairly well with figures which have been published from time to time.

Readers will find the last two columns useful for estimating. They give the percentages which the various items bear to the whole, and the average prices per kw. of plant installed.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

23,077. "Electrical sewing machinery." H. Chapman. Dated November 20th.

23,096. "Improvements in recording apparatus for use on telegraph cables and other lines." J. A. L. Dearlove. Dated November 20th.

23,100. "Improvements in electric lamp supports." H. Long. Dated November 20th. (Complete.)

23,102. "Improvements in contact breakers especially applicable to induction coils." G. Weissmann and A. Wydts. Dated November 20th. (Date applied for under Patents, &c., Act, 1883, Section 103, April 25th, 1899, being date of application in France.)

23,119. "Improvements in and relating to electric illuminating devices." P. Jean and A. Bouchon. Dated November 20th.

23,138. "For determining the flow of liquids including gases and electricity within given times." W. P. Miles. Dated November 21st.

23,141. "Automatic controlling arrangements for switches for direct-driven cage hoists and general electric and motor work." J. Goddard. Dated November 21st.

23,153. "Improvements in switches for use with rheostats for starting and controlling electric motors for lifts or the like." H. Hirst and F. O. Hurt. Dated November 21st.

23,154. "An improved electrical indicator." A. Eckstein and H. J. Coates. Dated November 21st.

23,216. "An improved switch." H. O. Joedicke. Dated November 21st. (Complete.)

23,219. "Improvements in or relating to electric signal alarm and safety devices for railways." A. J. Boult. (F. Cumont, Belgium.) Dated November 21st. (Complete.)

23,235. "An improvement in secondary voltaic batteries." H. Leitner. Dated November 21st.

23,241. "Improvements in holders for electric lamps." R. Alexander. (A. B. Vanes, Cape Colony.) Dated November 22nd.

23,267. "An improved trolley and connections for overhead electric traction or similar uses." G. J. Ball. Dated November 22nd.

23,283. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) Dated November 22nd. (Complete.)

23,284. "Improvements in electric circuit-breakers." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) Dated November 22nd. (Complete.)

23,285. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., United States.) Dated November 22nd, 1899. (Complete.)

23,288. "Improvements in enclosed electric arc lamps." The British Thomson-Houston Co., Ltd. (O. N. Wiswell, U.S.) Dated November 22nd. (Complete.)

23,289. "Improvements in controlling devices for electric motors." The British Thomson-Houston Co., Ltd. (W. B. Potter, U.S.) Dated November 22nd. (Complete.)

23,290. "Improvements in regulating rotary electric converters." The British Thomson-Houston Co., Ltd. (E. J. Berg, U.S.) Dated November 22nd. (Complete.)

23,291. "Improvements in systems of electrical distribution." The British Thomson-Houston Co., Ltd. (C. P. Steinmetz, U.S.) Dated November 22nd. (Complete.)

23,292. Improvements in electric locomotives or motor cars for adhesion and rack railways." THE BRITISH THOMSON-HOUSTON CO., LTD. (The Union Elektricitäts-Gesellschaft, Germany.) Dated November 22nd. (Complete.)

23,293. 'Improvements in trolley stands for electric railways." THE BRITISH THOMSON-HOUSTON CO., LTD. Dated November 22nd.

23,294. 'Improvements in and connected with electrical, gas, and other fittings." H. J. BANKS. Dated November 22nd.

23,315. "Improvements in and connected with electrolytic meters." A. WRIGHT and THE MUTUAL ELECTRIC TRUST, LTD. Dated November 23nd.

23,316. "Improvements in and connected with electrolytic meters." A. WRIGHT and THE MUTUAL ELECTRIC TRUST, LIMITED. Dated November 22nd.

23,318. "Improvements in electrodes for medical applications of electricity." R. HOUGHTON. Dated November 22nd. (Complete.)

23,319. "Improvements in artificial ear drums." L. B. ATKINSON. Dated November 22nd.

23,327. "Improvements in electrical and magnetic apparatus such as transformers, dynamos, and other appliances and alloys for use therein." R. A. HADFIELD and W. F. BARRETT. Dated November 22nd.

23,371. "Improvements relating to switches, specially applicable to switches for electromotors and the like." R. A. SLOAN and J. E. L. BARNES. Dated November 23rd.

23,381. "Cord shortener for electric light flexible cord pendants." L. DAKIN. Dated November 23rd.

23,400. "Improvements in electrical anodes." A. F. HARRIS. Dated November 23rd.

23,403. "Improvements in and relating to electric igniting apparatus useful for lighting cigars or for similar purposes." H. H. LAKE. (S. Abbott, U.S.) Dated November 23rd. (Complete.)

23,413. "Improvements in the construction of dynamo-electric machines." M. H. ROBINSON and M. H. P. R. SANKEY. Dated November 23rd.

23,435. "Improvements in or relating to electrical contact makers and breakers." J. W. MILLIGAN and F. OLDFIELD. Dated November 24th.

23,440. "An improvement relating to electric lamps." H. G. MASON. Dated November 24th.

23,448. "Improved automatic make and break for electric circuits." P. C. MCFARLANE of the Firm of J. WHITE. Dated November 24th.

23,504. "Improvements in receiving apparatus for Hertzian radiations or electro-magnetic waves." J. C. BAVIERA. Dated November 24th. (Complete.)

23,522. "An improved automatic electric cut-out." E. C. ST. JOHN. Dated November 25th.

23,541. "Improvements in or relating to electric ignition apparatus for explosion engines." H. J. LAWSON. Dated November 25th.

23,575. "Improvements in or relating to pulley blocks or lifting and lowering mechanism operated by electricity." E. W. TANGYE. Dated November 25th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

5,208. "Improvements in electrically operated gas valves for burners." The Aktiengesellschaft fur Fabrikation von Broncewaaren und Zinkguss, vorm, J. C. Spinn & Sohn and S. J. von Romocki. Dated March 3rd, 1898. Relates to gas valves for street lamps and other lamps or burners operated from a distance by means of electricity. Leakage is prevented and the appearance of the lamp or burner is improved, by arranging the conical or other valve, the electro-magnets and the spring armatures entirely within a casing. The valve is carried by the spring armature which holds it open until the armature is attracted by the electro-magnet. A catch on the spring armature then engages the armature and retains the armature and valve in the closed position until the catch is released by the attraction of the electro-magnet upon the armature, whereupon the spring armature lifts and re-opens the valve. In a modification the action is reversed, the parts being so arranged that the attraction of the electro-magnet upon the armature opens instead of closing the valve and the catch on the armature retains the valve in its open position. 3 claims.

5,423. "Automatic electric switch for hoists and cranes." J. Goddard. Dated March 5th, 1899. Relates to switches for hoists and cranes, applicable also for lighting purposes. A disc or drum is fitted with a series of contacts and a contact segment which rub against contact brushes fitted with springs. The segment (for a series motor) is connected to the positive main, the segments to the resistances and the segment to one terminal of the field coils, the other terminal being connected to the negative main. The brushes, which have square shafts, are removable, and are connected to the armature brushes. The various connections are made by flexible wire to allow movement of the disc. The spindle, which may be operated by hand or by a chain and chain wheel, is fitted with a stop to engage projections on the casing to limit the movement, and also with a pointer to indicate its position. The insulating segments may be so proportioned as to connect up either the armature or field magnets first. For lighting rooms or lamps in succession, the contacts are connected to the lamp circuits instead of to the resistances. 10 claims.

5,665. "Improvements in metallic conductors for protecting electric wires and cables." P. C. Middleton and F. Huggins. Dated March 8th, 1898. Relates to joining lengths of metal tubular conduits together and to angles, T pieces, and junction boxes. In the case of fitting tubes together, the end of the tube is reduced externally, and the end of the other tube is bored out to receive the end of the first. A sleeve with a central contracted portion may also be used to receive the ends of the tubes. In the case of angles, L's, and junction boxes, the ends of the branches or projecting lugs are bored out to receive the tubes and to form internal shoulders. The T pieces may be formed in longitudinal sections held together by clips. 6 claims.

5,703. "Improvements in electrodes for secondary batteries or accumulators." H. Pieper, fils. Dated March 8th, 1898. The electrodes are of a hollow cylindrical shape, and are built up of tiers of plates shaped in the form of hollow truncated cones, which are open at the top and bottom. The cones are alternately plain and radially corrugated. One electrode surrounds the other, and the radial channels in one are inclined in an opposite direction to those in the other, this difference being produced by fitting the cones together in one electrode with their bases downward, while in the other electrode the cones are fitted together with their bases upward. This arrangement of channels has for its object the circulation of the electrolyte. The electrodes are separated by glass rods, which are held in place by grooves in the electrodes. 2 claims.

5,704. "Improvements in electrodes for secondary batteries or accumulators." H. Pieper, fils. Dated March 8th, 1898. The electrodes are of a hollow cylindrical shape, and are built up of tiers of annular plates which are alternately plain and radially corrugated. One electrode surrounds the other and they are separated from each other by glass rods which are held in place by grooves. 2 claims.

5,705. "Improvements in the manufacture and production of electrodes for secondary batteries." H. Pieper, fils. Dated March 8th, 1898. Hollow cylindrical electrodes are made from a flat lead plate, which has ribs or projections extending from top to bottom and standing at right angles to the plane of the plate. The spaces between the ribs are filled with active material, and the plate is then bent into cylindrical form, with the ribs on the inner side. 1 claim.

6,451. "Improvements in apparatus for electroplating pins and other small objects." J. S. Morrison. Dated March 16th, 1898. Pins and small articles are tinned or nickelled in a perforated drum having one removable end for charging and discharging. The drum is supported by a horizontal shaft (coated with a non-conducting material) carried by bent iron pieces, and is rotated in a tank containing the electrolyte and the anodes. The small articles form the cathode, the current passing by pins to horizontal copper strips, thence to a metal ring and a conducting strip to a conducting disc, from which two pins or bolts conduct the current to an insulated copper or like ring to which the conducting wire is attached. The wire and ring are enclosed in a water-tight vulcanite sleeve. 2 claims.

6,535. "Improvements in propelling barges and boats on canals and other waterways by electricity." W. E. Konway and T. V. Hughes. Dated March 17th, 1898. Relates to means for applying the method of electric propulsion of carriages on tramways described in Specification No. 8,338, A.D. 1896, to barges and boats on canals and other waterways. Posts on the canal bank carry arms which support insulated electric wires on which a trolley runs and conveys the electric current by means of the inclined tube and telescopic standard to the motor on the vessel. The trolley is in two parts insulated by the disc and sleeve. The sleeve bears on the wire and delivers the current through the cap and insulated pin to the wire passing through the axial sleeve and the tube, and the sleeve bears on the return wire, and is in electrical communication with the sleeve and the tube. The paddle wheels are rendered buoyant by forming the central portions as drums, the depth of immersion being controlled by levers and the wheels are driven from the motor shaft by chain gearing and suitable clutches. In some cases the wheels may be lifted out of the water by a derrick. 5 claims.

6,605. "Improvements in telephone intercommunication system." W. Aitken. Dated March 18th, 1898. House or similar telephone systems are arranged with the circuit of any one station connected at all the other stations by means of branching or make and break jacks; in the latter case all intermediate stations are provided with double home jacks connected respectively to the right and left. The bell at each station is in a branch of a common line circuit including the battery. The branch is completed through the inner jack contacts, the called subscriber's line and the calling subscriber's plug through the instrument, home jack glasses; the pin is adjustable by means of a screw. The horizon pin is similarly adjustable. The pin carrying the pendulums is connected by a link with the index arm so as to move with it in the slot of a quadrant. A pawl on the pendulum can be engaged when desired with a rack to prevent the pendulum from swinging about. The pins have grooves in them to hold luminous paint for night work. In use, the object is observed directly, and the reflection of the pin brought into alignment with the object and the pin by moving the index arm. 2 claims.

6,633. "Improved apparatus for indicating the charge in a secondary battery." F. W. Cooke and T. Ireland. Dated March 18th, 1898. Quantity for indicating the available charge in storage batteries. A motor has its field windings in series with the battery and an armature connected by a commutator and brushes to the terminals of one cell of the battery, or other source of current. The armature thus rotates in opposite directions in charging and discharging. Its shaft is connected by a worm and gear wheels with a pointer in front of a dial marked "full" and "empty" or otherwise, to be intelligible to an unskilled attendant. The shaft carries a pin in engagement with a helical slot in a loose sleeve, arms of which support an iron ring above a stationary brake magnet, the windings of which are included in the armature circuit. When the shaft rotates in a charging direction, the ring moves nearer the brake magnet than when it rotates oppositely, thus varying the retardation to compensate for loss of energy in the battery. To prevent movement of the shaft owing to vibration, when no main current is passing, it carries a notched disc which is engaged by a spring-pressed lever, when an iron part of this is released by the adjacent pole pieces of the field magnet; this lever also opens the armature circuit. 3 claims.

6,649. "Improvements in dynamo-electric generators and motors." C. W. Atkinson and W. H. Johnson. Dated March 18th, 1898. Dynamos and motors. Relates to improvement in various details. Frames and casings. The frame is a spherical casting mounted upon a base plate provided either with a spherical recess struck from the centre of the casting or with a number of projections. The casting is secured by a screw, and to provide further adjustment the base plate may be slotted and be formed with a spherical surface, upon which fits an adjustable washer. Inspection openings formed in the frame are closed by pieces of glass, metal wire gauze or the like. Field magnets.—The magnets, which may be four in number, are formed upon the inner surface of the frame. The coils are wound upon the metal formers or bobbins stamped with projecting corrugations, and the ends of the wire are brought out through some of these corrugations. The bobbins are fixed in position by wedges of non-magnetic material driven in between adjacent pole-pieces, and pressing upon some of the corrugations on the bobbins. Armatures.—The core, which is built up of laminated plates in the usual way, is fixed to a shaft. One end of this shaft is mounted in bearings provided in a pocket which is formed at one side of the frame, and acts also as an oil holder. At the other side of the frame is an opening wide enough for the passage of the armature, and adapted to receive a cylinder which contains an oil well, and the bearings for the other end of the shaft. The armature and commutator are fixed in position by thin brass sleeves which are rolled into grooves in the shaft. The winding is of the drum type and the ends of the coils are carried round the ends of the armature upon thin cylindrical stampings or spinnings. Commutators.—An insulated sleeve receives in grooves parallel to the axis segments insulated from each other, and fixed in position by split rings of insulating material. These rings are clamped down by coned and screwed metal rings. The wires from the armature are attached to projections on the plates, and they are then enclosed by a metal stamping. Brush-holders and terminals, arrangement of.—The brush-holders are pivoted on metal supports fixed in insulating tubes which are cemented in the cylinder. The brush supports make contact with the magnet terminals, which are mounted in insulating tubes supported in recesses in the frame. 8 claims.

6,695. "Improvements in electrical measuring apparatus for use in regulating electric currents." R. E. B. Crompton and S. W. Ashley. Dated March 19th, 1898. Relates to arrangements for connecting voltmeters and ammeters so as to indicate the electrical pressure at any part of the circuit and also indicate the current. In one arrangement the generator supplies current through the mains to the translators at a distant point. The resistance box has three terminals. The terminal is connected to a point on the resistance. A switch is arranged in the circuit. Instead of employing one galvanometer, two or three may be connected so to the circuit as to give the required readings direct. 3 claims.

6,720. "Improvements in depressible rail systems for electrical railways." W. Grunow, jun., and Z. Goodsell. Dated March 19th, 1898. Relates to electric railways and tramways on a depressible rail system. The supply conductor is in the form of a third rail, which may be placed in a slotted conduit, and may be in insulated sections which are mounted so as to be depressed by the vehicle and thereby mechanically operate the switches. The conductor rails are carried in insulating U-pieces in yokes mounted on springs which are guided and protected, and their tension adjusted by bolts and casings. These supports are mounted on the switch boxes and also at intermediate points. Insulated wires attached to the rails are connected to V-shaped contacts which are carried by a plunger into contact with ears on a plate which is connected to the feeder. This plunger works through a stuffing box on the lid of the switch box, and is engaged by a lug on the depression rail. Or the rail may rest on the top of the plunger, the plunger being normally held by springs and being adapted to dip into mercury which is connected to the feeder. The rails may be in sections insulated from each other and laid with lap joints. Feeders may be introduced into the switch boxes, or the main conductor may be led through them, tubular extensions being provided and filled with insulating material which may also be used to secure the lids. A wheel for depressing the conductors and taking current is mounted in a spring held fork in a bracket. Or a pair of wheels are mounted on bent levers. They are operated by a bell crank lever and connections to the end of the vehicle. The wheels may have insulating material and wearing plates on their sides. Yokes shaped to straddle the sleepers, support plates or curved plates with external ribs and flanges are secured to the sleeper and support cover plates which form the slot rails. 26 claims.